The National Academy of Sciences

Abstracts of Papers Presented at the 1949 Autumn Meeting, Rochester, New York

Reflection and Transmission Type Interference Filters

A. F. Turner, *Bausch & Lomb Optical Company*
(Introduced by F. E. Wright)

Thin films may be combined to produce narrow band pass filters, which owe their effectiveness to interference. By means of high vacuum techniques, such film combinations have been satisfactorily produced up to a diameter of 8 in., and larger sizes are feasible. A filter for transmission is made by depositing successively a film of silver, a spacer film of a dielectric, and a second silver film. The thickness of the spacer film controls the wavelength position of the pass band. The optical properties of the silver limit the use of this filter to a wavelength range of about 350–750 mμ. The best optical performance is obtained in the middle of this range, where a filter with 40% transmittance will have a half-width of 10 mμ. The wavelength range may be greatly extended with a reflection type filter in which the film sequence is opaque aluminum, followed by several transparent aluminum films separated by dielectric films. Such filters are operative from the ultraviolet into the infrared, but have relatively wide pass bands. In the visible a typical filter has a peak reflectance of 90%, with a half-width of 60 mμ. Both types of filter will be demonstrated.

Diffraction Gratings of Improved Efficiency

David Richardson, *Bausch & Lomb Optical Company*
(Introduced by F. E. Wright)

The efficiency of a grating is determined principally by the contours of the grooves and the reflectivity of its surface. The shape, orientation, and loading of the ruling diamond must be carefully controlled if the desired groove shape is to be achieved. The microinterferometer has proved to be invaluable for observing the groove shape of preliminary test rulings and thus assuring the correct adjustment of the diamond. Energy distribution measurements of completed gratings indicate the value of the method.

Invariants and Symmetry and Their Use in Geometric Optical Problems

Max Herzberger, *Eastman Kodak Company*
(Introduced by W. Albert Noyes, Jr.)

An optical system is in general symmetric around an axis. A special type of optical system is one with central symmetry, consisting of a series of spheres with the same center. The author has developed, together with his friend, H. Boegehold, a theory which gives complete information about their image formation. This leads to a new image error theory, in which symmetry or the lack of it is used as a method for analyzing an optical image.

In a system with point symmetry, there exists an invariant vector for every ray trace. In a system with areal symmetry, there exists an invariant scalar. The author has transformed the formula for tracing a ray or a bundle of rays through an optical system into a form in which the invariant scalar or vector forms one of the given data. This permits ray tracing to be reduced by one dimension—an important reduction, since the graphical methods connected with this step are a guide in the difficult problem of correcting an optical instrument.

Developments in the Field of Ultraviolet Microscopy

John V. Butterfield, *Bausch & Lomb Optical Company*
(Introduced by F. E. Wright)

The original conception of the ultraviolet microscope was evolved from a desire to extend the resolution limit of the microscope beyond the limit imposed by visual wavelengths. Of equal, and at present perhaps even greater importance, are its applications in biochemistry for direct photographic recording of biological tissue or for microphotometric determinations of biochemicals. With the advent of achromatic objectives applicable to the ultraviolet, the manipulation of the microscope in this region has been simplified, and the usefulness of the instrument extended considerably.

Fluctuations in the Photoconductivity of Films of Lead Sulfide

Brian O'Brien, Harry D. Polster, and Walter P. Siegmund
Institute of Optics, University of Rochester
(Introduced by W. A. Noyes, Jr.)

The concept that photoconductivity in thin films of heavy metal sulfides is due to photosensitive barriers between regions of excess and defect conductivity has received considerable support from several recent investigations in which a film surface has been scanned with a small spot of light. To extend this, provision has been made for exploring such surfaces with much smaller light spots, limited in minimum size only by the diffraction pattern of a high numerical aperture objective. An interrupted tungsten filament source is projected on the film with an apochromatic system corrected for the near infrared, and yielding an image of effective width about 1.5 μ. The photoconductivity appears as an alternating voltage recorded by a curve-drawing instrument synchronized with the film scan.

Films of lead sulfide formed by distillation and by wet precipitation have been investigated. The photoconductivity shows large and rapid fluctuations with position of the illuminated spot, which are highly reproducible in successive traces. Photoconductivity may change by a fac-

tor of two or more in a distance of 10 μ. However, the most common pattern observed consists of sharp drops below, rather than sharp peaks above, a general level of photoconductivity, which is difficult to reconcile with a barrier theory.

Correlations between Photographic and Photoconductive Sensitivity in Silver Halides: The Effects of Silver Sulfide and of Divalent Positive Ions

W. West and B. H. Carroll, *Eastman Kodak Company*
(Introduced by W. Albert Noyes, Jr.)

The electrical conductivity of photographic films changes slightly on exposure to light, the effect being measurable in some cases at exposures corresponding to normal latent image formation. The usual effect is an increase in conductivity, corresponding to liberation of electrons by light. It has been found that chemical sensitization of emulsions by compounds forming silver sulfide decreases the photoconductivity. The decrease is about 50%, which is a reasonable value for the trapping of electrons by the sensitivity nuclei. The evidence indicates that emulsion grains contain many shallow traps for electrons, to which chemical sensitization adds a few deep traps.

Silver bromide containing small amounts of lead or cadmium bromide has increased electrolytic conductivity and darkens very slowly on exposure to light. It has been found that fused, unannealed films containing these divalent cations show normal photoconductivity, although corresponding films of pure silver bromide decrease in conductivity on exposure. This result may be explained best in terms of Mitchell's theories of sensitivity, based on the existence of Schottky defects.

The Theory of Micrometeorites

Fred L. Whipple, *Harvard College Observatory*
(Introduced by L. H. Adams)

The term *micrometeorite* is here defined as an extraterrestrial body that is sufficiently small to enter the earth's atmosphere without being damaged by encounter with the atmosphere. The limiting circumstance arises when the micrometeorite radiates energy rapidly enough that its temperature remains below its melting point as its motion is retarded by atmospheric resistance. The theory of the maximum dimension for such a particle with prescribed geocentric velocity and physical characteristics is developed in this paper. The solution depends upon the height-density relation adopted for the atmosphere. Two types of such relations permit explicit solutions for the limiting ratio of meteoric mass to radiating area, or, if the particle is spherical, for the limiting radius. These atmospheric relations are a) constant temperature, and b) constant temperature gradient, both for constant molecular weight with respect to height. The second case appears to give a sufficiently accurate results for present needs.

The limiting radius for a spherical micrometeorite varies approximately as the fourth power of the melting temperature, the inverse cube of the velocity, the inverse logarithmic density gradient at the point of maximum temperature, and the secant of zenith distance. Heights of maximum temperature increase with velocity but lie in the neighborhood of the E-layer. For an iron meteorite at a velocity of 23 km/sec, the limiting spherical radius is 3–5 μ. Long cylindrical particles may have a minor diam of 4–7 μ—in good agreement with the minor dimensions of the "wedge-shaped opaque" magnetic particles that H. E. Landsberg associated with the great Giacobinid meteor shower in October 1946 (velocity 23 km/sec). His larger "round" particles (20–40 μ diam) may have been partially vaporized. This general agreement provides secondary confirmation of the assumed atmospheric relations at the 100-km level.

The writer heartily encourages the collection and study of micrometeorites, as they may provide the only laboratory samples of cometary material; ordinary meteorites probably arise from a different source. Deep oceanic sediments, as suggested by the *Challenger Expedition*, polar snows, or even geological strata may also contain evidence of astronomical phenomena.

Chemical Constitution and Photographic and Allergenic Activities of Color-forming Developing Agents

A. Weissberger, *Eastman Kodak Company*
(Introduced by W. A. Noyes, Jr., Chairman, Local Committee on Arrangements)

The only developing agents useful for processes involving formation of dyes in the photographic layer are *p*-aminodialkylanilines. These compounds are, as a class, rather weak developing agents. Moreover, they cause a sensitization dermatitis like poison ivy.

A considerable number of compounds were synthesized and their polarographic half-wave potentials and developing and color-forming activities were measured. The results lead to an understanding of the electrochemical and sterical factors which regulate the activity of these developing agents. Groups which increase the affinity of the compounds to gelatin (keratin) and decrease their lipoid solubility reduce their allergenic properties. A number of photographically highly active, low allergenic, dye-forming developing agents have been synthesized.

On the Possible Existence of Antinucleons

J. Ashkin, T. Auerbach, and R. Marshak
University of Rochester
(Introduced by W. A. Noyes, Jr.)

Recent evidence for the gamma instability of neutral mesons and the possibility of detecting relativistic charged mesons in the new electron-sensitive plates renews interest in the possible existence of antinucleons, in particular negative protons. Rigorous expressions have been obtained for the annihilation cross sections of proton pairs using weak coupling theory and spin zero mesons. The annihilation cross section vanishes in the limit of zero velocity for the emission of two neutral mesons but reaches a maximum for the emission of two charged mesons. The charged meson annihilation therefore dominates over the proton annihilation. The total

probability for annihilation of the negative proton in flight has been computed, taking account of its ionization loss and the effect of nuclear collisions. The prospects of detecting negative protons annihilating in flight or at rest in photographic plates exposed at 100,000 ft appear hopeful.

Proton-Proton Scattering

C. L. Oxley, Physics Department, *University of Rochester*
(Introduced by W. A. Noyes, Jr.)

This paper is to review the proton-proton scattering program at Rochester, to present future plans of the program, and to connect the program with the problems of the field and with work in other laboratories.

General features of the Rochester program are photographic plate experiments with the small cyclotron at energies of 7 Mev and less, counter experiments with the undeflected beam of the new synchrocyclotron at energies from 250 Mev to 50 or 100 Mev, and a search for inelastic proton-proton scattering as might occur with the excitation of isobaric proton states.

The program was initiated by and has progressed with the guidance of S. W. Barnes. Support is derived from grants of the Research Corporation and the joint program of the Office of Naval Research and the Atomic Energy Commission.

Prediction of Compressibility of Real Gases and Gaseous Mixtures from Critical Pressure and Temperature

Gouq-Jen Su, Ramesh G. Soparkar and Robert J. Lockhart
Department of Chemical Engineering,
The University of Rochester
(Introduced by W. A. Noyes, Jr.)

Based on a modified "law" of corresponding states, a system of generalized isometrics is presented, covering experimental data on seventeen gases over wide ranges of pressure and temperature and seeming to be applicable to all gases. A ternary gaseous mixture consisting of methane, *n*-butane and decane at five different compositions has been studied. Calculated and experimental values of compressibility factors agree well. Calculated changes of enthalpy with pressure, making use of a generalized form of the Beattie-Bridgeman equation of state, for the methane-ethane system agree well with experimental values reported in literature. The same method may be used to calculate isothermal changes of other thermodynamic functions.

The proposed method of correlating pressure-volume-temperature data by the generalized relationship has the advantage of not requiring knowledge of the critical volume.

The Heavy Nuclei of the Primary Cosmic Radiation

H. L. Bradt and B. Peters, *University of Rochester*
(Introduced by W. A. Noyes, Jr.)

The abundance of atomic nuclei of the light elements in the primary cosmic radiation has been determined at geomagnetic latitudes $\lambda = 30°$, 51°, and 55° with the aid of photographic emulsions exposed in balloon flights at 100,000-ft altitude.

The abundance ratios may be compared with the abundance of the atoms of the light elements in stellar atmospheres and interstellar space.

The most abundant nuclei in the primary cosmic radiation are H nuclei (relative intensity = 10,000). Next come He nuclei (1000), nuclei of C, N, O, and possibly F or Ne (60), nuclei of Mg, Si and neighboring elements (10) and nuclei of charge $Z > 15$ up to the neighborhood of Fe (10).

The abundance of nuclei in the primary cosmic radiation may be determined by several factors, among them: (a) the abundance of atoms (or ions) in the region where acceleration took place; (b) the dependence on charge and mass of the efficiency of the acceleration process; and (c) the breakup of heavier nuclei into lighter ones by collision with interstellar H atoms. This latter factor will be important if cosmic rays are of galactic origin.

The relative importance of factors (a) and (c) may be obtained from a determination of the abundance of primary nuclei whose cosmic abundance is known to be extremely low (Li, Be, and B).

The Pre-exponential Factor for Some Reactions of Methyl Radicals

Leon M. Dorfman and Robert Gomer
Department of Chemistry, The University of Rochester
(Introduced by W. A. Noyes, Jr.)

Recent kinetic data on the role of methyl radical reactions in the photochemistry of various compounds permit the evaluation of relationships between the pre-exponential factor for the association reaction

$$CH_3 + CH_3 = C_2H_6$$

and that for hydrogen abstraction reactions of the type

$$CH_3 + RH = CH_4 + R$$

Evaluation of the relative steric factors is possible upon the assumption of arbitrary collision cross sections for these reactions. For the reaction of methyl radicals with acetone, dimethyl mercury, ethylene oxide, butane, and ditertiary butyl peroxide, the data indicate that the steric factors for the methane-forming reactions are lower than has normally been assumed. On the basis of these data an upper limit of $p \simeq 5 \times 10^{-4}$ must be assigned.

γ-Aminobutyric Acid: A Constituent of the Potato Tuber?

F. C. Steward, J. F. Thompson,[1] and C. E. Dent[2]
University of Rochester
(Introduced by W. Albert Noyes, Jr.)

The first examination by Dent, Stepka, and Steward of the free amino acids of the potato tuber by partition chromatography on paper revealed 27 different substances which react with ninhydrin. Of these substances 21 were either amino acids or amides or their derivatives which, though they may not have been previously demonstrated

[1] Postdoctoral Fellow, National Institutes of Health.

[2] Present address: University College Hospital, London, England.

in a single plant extract, were nevertheless known to occur in plants. Three unidentified substances reacted like amino acids to ninhydrin. Of these, two occurred only in small amount, one was tentatively recognized as β-alanine, but the third was present in relatively large amount. It is this substance, which—after glutamine and asparagine—is the most abundant soluble nitrogen compound in the potato tuber, that is now recognized as γ-aminobutyric acid.

γ-Aminobutyric acid occurs in the phenol: collidine-lutidine chromatograms in a position almost immediately below that of value. The naturally occurring product may be isolated by the methods of paper chromatography and freed from all other known ninhydrin-reacting compounds. It is stable to hydrolysis and to hydrogen peroxide and is chromatographically identical with synthetic γ-aminobutyric acid (prepared from the lactin). Since, however, this acid has not hitherto been recognized as a normal constituent of plants, some confirmation by an alternative method is desirable.

As isolated by paper chromatography from cold alcoholic extracts of potato tuber, the γ-aminobutyric acid is difficult to crystallize—more so than the synthetic product when present in comparable amount. This appears to be due to a substance which does not react with ninhydrin but which causes the formation of a nonerystalline glass. This has made it difficult to obtain satisfactory x-ray diffraction patterns to compare with those of crystalline synthetic γ-aminobutyric acid.

One of us (C. E. Dent) has, however, shown that γ-aminobutyric acid forms a compound on boiling with urea in presence of copper salts. This compound can be adsorbed on acid alumina. The ureide takes up a characteristic position on the standard phenol: collidine-lutidine chromatograms near to that of methionine sulfone, where it may be detected by a yellow color formed with acid *p*-dimethyl-aminobenzaldehyde. In this behavior the natural product from potato tuber exactly matches the synthetic substance. However, pure γ-aminobutyric acid or its ureide have not yet been isolated in sufficient quantity for ultimate analysis. The identity of this substance as a normal constituent of the potato tuber seems, however, to be certain.

The analysis, by quantitative paper chromatography, of the alcohol-soluble nitrogen compounds of the potato tuber (variety Katahdin) shows that the amount of γ-aminobutyric acid present is greater than that of any amino nitrogen compound other than glutamine and asparagine. The content of the major constituents is here recorded in the approximate sequence in which they occur on the chromatograms, and in the units μg/g fresh weight, as follows: aspartic acid, 161; glutamic acid, 121; serine, 108; asparagine, 2300; threonine, 52; alanine, 189; glutamine, 2493; γ-aminobutyric acid, 540; valine, 358; leucine, 478. Thus γ-aminobutyric acid accounted for about 5% of the alcohol-soluble and for 3.7% of the total nitrogen in these tubers.

Glutamic acid decarboxylase activity in the tubers was demonstrated manometrically but the activity was small; so that it is even open to question whether the γ-aminobutyric acid does arise by decarboxylation of glutamic acid (α-aminobutyric acid, the other possible decarboxylation product, occurs in potato only in minute amounts). In view of the importance of glutamic acid and glutamine in nitrogen metabolism, the role of γ-aminobutyric acid and its relation with these substances is of great interest.

γ-Aminobutyric acid does not occur among the hydrolytic products of potato proteins; it is, however, utilized as a nitrogen source if the potato cells are brought under conditions conducive to protein synthesis.

From the evidence of chromatography, free γ-aminobutyric acid seems to be somewhat widespread in plants.

Electric Moments of Polar Polymers in Relation to Their Structure

Peter Debye and F. Bueche, *Cornell University*

From the observed angular dissymmetry of the light scattered by polymer solutions it has been possible to draw conclusions on the average size of the polymer coil. In general, the actual coil diameter found in this way is much larger than that calculated from a model with free rotation. (For polystyrene in benzene the factor is about 3.5). This increase in size can satisfactorily be attributed to hindering of rotation around the chemical bonds. In order to obtain information about structural details of this hindered rotation, however, the size determination will have to be combined with evidence derived from other sources than light scattering. As such, the dipole moment, as derived from measurements of the dielectric constant of polymer solutions, obviously is a good choice. If N polar monomers are influenced independently by the electric field, their contribution to the polarization will be N times the contribution of a single monomer. If they are connected to each other in the chain, the contribution of the whole chain may be larger or smaller, depending on whether positions of parallelism or antiparallelism of the elementary electric moments are preponderant, taking the average over all the possible forms the coiling molecule can assume. A theory of this effect has been worked out and experiments have been carried out on solutions of several polar polymers. One of the examples is *p*-chloropolystyrene, for which the average contribution to the polarization of one chain element is substantially smaller in the polymer than that of the corresponding monomer.

Adsorption Isotherms and Liquid Solutions

George Scatchard, *Massachusetts Institute of Technology*

It has long been known that Langmuir's equation for monolayer adsorption is identical in form to the equilibrium expression for chemical reaction between quasi-perfect gases or quasi-ideal solutes. The Brunauer-Emmett-Teller equation for multilayer adsorption may be shown by factoring to have the same form as the equilibrium expression for a chemical reaction between the solvent and solute in a quasi-ideal solution in which each mole of solute, on the average, can react with one mole of solvent.

Factoring offers a simple and reasonable, but not very useful, method of adding a third parameter to the BET equation. Its chief use for surfaces is to enable a large scale picture even at high activities.

For liquid solutions the method gives a measure of the deviations from ideal solution laws, analogous to the activity coefficient or osmotic coefficient, which is especially adapted to the study of combination in quasi-ideal solutions without association. Association and electrostatic interaction are relatively unimportant in concentrated solutions.

For salt solutions in water, the hydration is much greater than mole per mole. The most important extensions are for different intrinsic constants for hydration of anion and of cation and for constants changing with the number of groups added, and next come the variations in activity coefficients with changing composition.

The Saturation Equation in Chemical Kinetics

W. H. Rodebush, ***University of Illinois***

One can easily demonstrate that the typical adsorption isotherm, expressed mathematically in various forms, is only a special case of a much more general type of phenomenon which appears wherever molecular interactions occur. Olsen has applied the idea to the activity of strong electrolytes. The same idea turns up repeatedly in homogeneous catalyzed chemical reactions where a catalyst or inhibitor at first shows effects proportional to concentration and then gives diminishing returns. In the absence of a better term, the phenomenon may be described as saturation and so represented by a typical curve. Since "pure" uncatalyzed reactions are of academic interest chiefly, it is felt that this idea may be of considerable practical significance.

Factors Determining Solubility among Nonelectrolytes

Joel H. Hildebrand, ***University of California***

The variety of factors that must be considered in interpreting solubility relations among nonelectrolytes will be illustrated by the solubilities and colors of iodine in solvents of various types. New, unpublished data obtained for this purpose will be considered, along with the extensive body of information available from previous work. The theory of regular solutions, with its formulations of the energy and entropy of mixing, will be applied to the violet, "regular" solutions, which represent over a thousandfold range in solubility, and the deviations therefrom which may result from dipole moments, hydrogen bonding, molecular shapes and sizes, or acid-base interaction will be discussed.

Cyanic Acid and the Allophanates

John R. Johnson and Louis L. Ferstandig
Cornell University

Studies have been made of the mechanism of the reaction of cyanic acid with alcohols to form esters of allophanic acid, R—O—CONHCONH$_2$. The evidence indicates that neither "dicyanic acid" nor the alkyl carbamate is an intermediate under the usual conditions for transforming alcohols into allophanates.

The mechanism of hydrolysis of allophanates in neutral, acidic, and basic media has been investigated. Allophanates of tertiary and allylic alcohols undergo hydrolysis rapidly in neutral aqueous medium at 100° by a process involving cleavage of the alkyl-oxygen bond. Under alkaline hydrolytic conditions the alkyl-oxygen bond remains intact.

The allophanates are crystalline compounds particularly suited for characterization of tertiary alcohols.

Studies in Diagnostic Cinefluorography: Familiar Radiographic Views as Seen in Slow Motion

G. H. S. Ramsey, J. S. Watson, Jr., J. J. Thompson, F. Dreisinger, R. T. Weinberg, and S. Weinberg
University of Rochester
(Introduced by Wallace O. Fenn)

Equipment designed and built in the Department of Radiology, University of Rochester, has been used to produce a cinematographic record of the shadows produced by x-rays on the fluorescent screen. A number of scenes have been incorporated in a film that will be shown. This film will serve to demonstrate the range of usefulness of this method of study in teaching, diagnosis, and research.

Production and Utilization of Plasma Proteins Studied with Radioactive Lysine

Leon L. Miller, ***University of Rochester***
(Introduced by George H. Whipple)

DL-Lysine labeled with C^{14} in the epsilon position has been fed to normal dogs and the relative apparent rates of incorporation of the labeled amino acid in the various plasma protein fractions have been studied. The data indicate that the plasma globulin fraction is synthesized more rapidly than the plasma albumin. This conclusion is substantiated by experiments in which plasma proteins labeled with C^{14} were transfused into a normal recipient dog. Here the labeled globulin fraction disappears from the circulation faster than the labeled albumin fraction. These experiments permit estimates of the half-life of the plasma albumin and globulin fractions.

In vitro studies of surviving rat livers perfused with whole blood containing added DL-lysine-ε-C^{14} have yielded direct evidence of the hitherto presumed role of the liver in the production of plasma proteins.

Hemoglobin Synthesis and Turnover in Dogs Measured with Radioactive Lysine

Charles L. Yuile, ***University of Rochester***
(Introduced by George H. Whipple)

Following the feeding of racemic lysine labeled with C^{14} to an essentially normal dog, about 70% of the total incorporation that occurred in hemoglobin in a 12-day period took place in the first three days. In an anemic and hypoproteinemic dog 80% of the maximum incorporation occurring over a period of 22 days took place in the first five days. These data suggest that the period of bone marrow maturation of the red cell during which its related hemoglobin is synthesized does not exceed three to five days. Evidence based on the rate of decrease of the C^{14} content of circulating blood cells over a prolonged period indicates an average life span of 115 days for the erythrocytic protein, which corresponds closely to estimates of the life span of dog erythrocytes by other methods. Fol-

lowing breakdown of blood erythrocytes, the protein comprising them is not used preferentially for the formation of new erythrocytes.

Solubilization and Separation of Components of the Heart Muscle Oxidase System

Elmer Stotz, *University of Rochester*
(Introduced by Wallace O. Fenn)

Cytochrome oxidase, cytochromes A, B, and C, and succinic dehydrogenase have long been recognized as having prime importance in the oxidative capacity of animal, bacterial, and probably of many plant cells. Heart muscle, because of its high content of these substances, has been a favorite tissue for study. Ground heart muscle can be extensively washed with water without removing these substances, although a weakly alkaline extraction with grinding yields a preparation of finely suspended insoluble particles containing all of the above components. Only cytochrome C, because of its exceptional stability toward acid, has been shaken loose from its combination with these particles and satisfactorily characterized. The other components remain attached, have been unsusceptible to the usual methods of protein purification, and are consequently ill-defined as chemical entities.

Following leads provided by studies of natural digestive processes, the heart muscle particle suspension has been dispersed by the addition of sodium cholate and subjected to the digestive action of several types of enzymes. After the action of some of these enzymes, the particles are so reduced in size that the cytochrome oxidase activity nearly all remains in solution upon centrifugation at 20,000 *G*. Furthermore, the digested preparation is then susceptible to a fairly sharp fractionation with ammonium sulfate. The oxidase has thus been purified several fold and is free of cytochrome C, but still contains cytochromes A and B and some succinic dehydrogenase.

Suitable modification of the above procedure has led to cytochrome A preparations with very low cytochrome oxidase activity. With the same starting material a soluble succinic dehydrogenase, highly concentrated and purified about 40×, has been obtained. With the various compounds brought into soluble form, the application of classical protein fractionation procedures may lead to further purification and separation of the components, whose interrelationships in oxidative metabolism may then be revealed.

The Phenomenon of Gel Formation by Isolated Cell Nuclei

Alexander L. Dounce, *University of Rochester*
(Introduced by Wallace O. Fenn)

The formation of gels as the result of adding dilute ammonia or strong saline solutions to different types of isolated cell nuclei has been described previously. In this paper further observations are reported on gel formation by isolated nuclei, particularly those obtained by a modification of the technique of Behrens. It is shown that nuclei isolated from rat liver or rat tumor (Walker carcinoma 256) at pH 4.0, or lower, form a gel upon adding dilute ammonia or sodium hydroxide, whereas nuclei obtained from chicken erythrocytes at pH 6.8, as well as nuclei isolated from rat liver or tumor by the modified Behrens technique, yield a gel upon adding strong saline as well as dilute alkali.

It is assumed that the desoxyribonucleic acid of the nuclei is responsible for gel formation. The fundamental reactions involved are thought to be as follows:

1. Nuclei prepared at low pH in aqueous media:
   a) H-DNA + NaOH ⟶ Na-DNA + H_2O.
      The Na-DNA is the gel-forming substance.
   b) H-DNA + NaCl—no reaction.
2. Nuclei prepared at pH 6.0 to 7.0 in aqueous media or by the Behrens technique:
   a) Hs-DNA + NaOH ⟶ Na-DNA + Hs-OH.
   b) Hs-DNA + NaCl ⟶ Na-DNA + Hs-Cl.
      Again the Na-DNA is the gel-forming substance.

In these equations, H-DNA stands for free desoxyribonucleic acid; Hs stands for histone, and Hs-DNA for the nucleohistone.

Nuclei prepared at pH 6.0 from normal rat liver by the use of very dilute citric acid do not form a gel, although they yield a highly polymerized, easily extractable sodium salt of desoxyribonucleic acid. The sodium salt of the desoxyribonucleic acid of nuclei capable of forming gels is, on the other hand, difficult or impossible to extract and it is thought that the latter type of nucleic acid represents a hitherto unrecognized "native" nucleic acid present in the intact cell, whereas desoxyribonucleic acid extracted even by mildest methods thus far available represents the product of some kind of intracellular autolysis or degradation.

A New Analytical Method for Adrenal Cortical Hormones

Robert B. Burton, Alejandro Zaffaroni, and E. Henry Keutmann, *University of Rochester*
(Introduced by George H. Whipple)

An adaptation of the technique of paper partition chromatography, utilizing nonaqueous solvent systems, is the basis of a new method for analysis of adrenal cortical hormones. The procedure permits separation and identification of microgram quantities of the individual cortical hormones in mixtures of known compounds, and in urinary and adrenal extracts.

Evidence will be presented which indicates the presence of Kendall's Compound E and 17-hydroxycorticosterone in extracts of urine from normal individuals.

Estimation of Physical Fitness

Robert A. Bruce, Frank W. Lovejoy, Jr., Paul N. G. Yu, Raymond Pearson, and Marion McDowell
University of Rochester
(Introduced by George H. Whipple)

A preliminary appraisal of the estimation of physical fitness from cardiorespiratory measurements during a standardized stress of exercise has been made in healthy normal subjects, as well as in patients with a variety of diseases, especially of the heart and lungs. The method involves a battery of simultaneous and continuous observations of ventilatory, respiratory, and circulatory per-

formance, including electrocardiographic changes, before, during, and after walking on a motor-driven treadmill at a moderate rate for a fixed period of time, or to the limits of tolerance. The duration of the walking effort times the average respiratory efficiency during exercise divided by the total pulse for the first three minutes of recovery equals the fitness index. This index shows a satisfactory correlation with clinical performance and symptomatic distress in ambulatory patients with disease. The spectrum of results ranges from complete and total disability in abnormals to better than average performance in normals. The limiting factors to physical fitness are chiefly circulatory; accessory studies in various patients provide further insight into these mechanisms.

The Work of Breathing

Wallace O. Fenn, Arthur B. Otis, and Hermann Rahn
University of Rochester

During breathing, the respiratory muscles do work in overcoming the elastic forces of the lungs and chest, viscous resistance of the air and tissues, turbulence of the moving air, and inertia. Measurements have been made to determine how the total work of breathing is subdivided among these various fractions. From such data, the respiratory apparatus can be described as a mechanical system. For any given minute volume of ventilation of the lungs this system has a frequency that is optimal (in the sense of minimal work), because if the frequency is too slow the elastic work becomes very great and if the frequency is too rapid much work is wasted in ventilating the dead space (air passages to the lung). Calculated optimal frequencies agree reasonably well with the frequencies observed in normal breathing. The theoretical maximal work that can be done by the respiratory muscles has been estimated on the basis of direct measurement of pressures that can be developed by the chest at various volumes and by calculation from anatomical data assuming that the respiratory muscles have properties similar to those of other skeletal muscles. Good agreement was obtained between the results of the two methods.

Hemolytic Anemia in Newborn Dogs Due to Absorption of Isoantibody from Breast Milk During the First Day of Life

Richard M. Christian, Donald M. Ervin, Scott N. Swisher, William A. O'Brien, and Lawrence E. Young
University of Rochester
(Introduced by George H. Whipple)

Four different antigenic factors have thus far been identified serologically in dog erythrocytes. One of these which may conveniently be called the "Do factor" appears to be somewhat analogous to the Rh factor of human red blood cells. Dogs lacking this factor in their red corpuscles are accordingly labeled "Do-negative" and those whose cells contain this factor are called "Do-positive."

Do-negative bitches that have been immunized by transfusions of Do-positive blood develop Do-antibodies that appear in high concentration in the colostrum after pregnancy and persist for several weeks in the breast milk. Experience with nine litters has shown that Do-positive puppies regularly develop hemolytic anemia if they suckle such an immunized dam during the first day or two of life. The lack of antibody absorption from milk after the second day has not yet been explained. There is evidence that natural immunization of the dam by fetal red cell factors may occur during pregnancy, thus producing hemolytic disease in dogs similar to that recently discovered as a naturally occurring phenomenon in horses.

The Electronic Spectra of Sulfur Hexafluoride

A. B. F. Duncan, ***Department of Chemistry, University of Rochester***
(Introduced by W. A. Noyes, Jr.)

The electronic transitions of lowest energy in SF_6 were found to lie far in the vacuum ultraviolet region. The transition of lowest energy is at 1054 A, and a few additional transitions were observed below a strong continuous absorption, which begins at about 815 A.

A theory of the electronic energy levels has been developed, based on the method of molecular orbitals. The orbitals employed were linear combinations of fluorine and sulfur atomic orbitals, chosen with regard to the established octahedral symmetry of SF_6. The relative energies of the orbitals are computed in terms of integrals over atomic orbitals of the Slater form. Use was made of the experimental S–F distance and relative electronegativities of the atoms, but no other experimental data were available. Probable transitions of lowest energy are predicted, with estimates of the corresponding intensities.

Vapor-Liquid Equilibria in Synthetic Rubber Latex-Monomer Systems

O. E. Dwyer, L. C. Liberatore,[3] and W. A. Gleich[4]
Department of Chemical Engineering, The University of Rochester
(Introduced by W. A. Noyes, Jr.)

Two systems were studied—styrene/latex and α-methyl styrene/latex. The styrene/latex system could be more completely described as the styrene-polymer-water system, since the latex was essentially an emulsion of soap-stabilized butadiene-styrene copolymer in an aqueous medium which was more than 99.9% water. Similarly, the AMS/latex system could be described as the AMS-polymer-water system, where the polymer is actually a copolymer of butadiene and α-methyl-styrene.

The chemical and colloidal natures of the systems were such that a static, rather than a dynamic, method of equilibrium measurement had to be used. Data were obtained over temperature ranges of 40–95° C for both systems, styrene-polymer ratios up to 0.17, and AMS-polymer ratios up to 0.30. The experimental data agree quite well with vapor-liquid equilibria calculated on the basis of theoretical considerations. During and since the war, considerable advances have been made in understanding the thermodynamic behavior of polymer-solvent systems. Experimental measurements, particularly swelling meas-

[3] Present address: Taylor Instrument Co., Rochester, New York.

[4] Present address: Shell Chemical Corporation, Houston, Texas.

urements, combined with statistical mechanical treatment, have led to expressions for entropy and enthalpy changes in solvent-polymer interaction.

Curariform Activity and Chemical Structures[5]

V. Boekelheide, *University of Rochester*
(Introduced by W. A. Noyes, Jr.)

The use of drugs having curariform activity in the treatment of certain spastic and hyperkinetic disorders has demonstrated the need for a satisfactory drug of this type. An investigation of certain synthetic and natural drugs has been undertaken in the hope of relating curariform activity to chemical structure.

The compounds, prepared for study as possible peripheral curaiform agents, have included derivatives of piperidine, the tetrahydro-β and γ-carbolines, quinolizidine, benzyltetrahydroisoquinoline, and indolylmethyltetrahydroisoquinoline. Of these the indolylenethyltetrahydroisoquinoline derivatives showed the highest activity, which is of interest in view of their possible relationship to the calabash curare alkaloids.

In regard to compounds causing muscular relaxation through a central effect, several interesting results were obtained. It was found that β-erythroidine, a peripheral agent, is converted by acid to a derivative, apo-β-erythroidine, which has a central action of long duration. It was also discovered that a group of compounds of rather simple structure, derivatives of 4-hydroxymethyl-1, 3-dioxolane, have high activity as central agents in effecting muscular relaxation.

The Formation and Structure of Some Vinyl-derived Polymers with Heterocyclic Rings

L. M. Minsk, *Eastman Kodak Company*
(Introduced by W. Albert Noyes, Jr.)

Two polymers containing heterocyclic rings derived by reaction upon preformed linear polymers will be discussed. Though purely synthetic in nature, these have certain physical properties found in naturally occurring materials. The method of preparation will be given and some proof of structure presented. The first of these polymers belongs to the family of ester-lactones and is derived from poly-α-chloroacrylic acid by reaction with an alcohol. It has certain of the physical properties of cellulose and cellulose esters, as well as a structure which in one particular respect is related to cellulose. The other is a highly imidized polyacrylamide, whose aqueous solutions will, under suitable conditions, yield thermally reversible gels. The general phenomenon of gelation, viewed from the behavior of this polymer, will be discussed.

Problems in the Experimental Study of Flash Burns

Herman E. Pearse, *University of Rochester*
(Introduced by Wallace O. Fenn)

The brief exposure to a high intensity of thermal energy causes a lesion called a "flash burn." This was first seen at Pearl Harbor, but its importance was not fully appreciated until the study of the atomic bomb casualties at Nagasaki and Hiroshima; there were approximately 68,000 cases of burns at Hiroshima alone. This tremendous clinical problem needs further experimental study.

We have succeeded in creating the lesion both by igniting an inflammable substance and by using a large carbon arc with a shutter mechanism.

This discussion deals with the problems of devising suitable sources, of measuring the energy and spectrum they create, of calibrating the energy delivered, of analyzing the threshold of the energy and its spectral components in burn production, of determining the time-temperature relationships of these, and finally of comparing the flash burn with the ordinary low temperature burn from the standpoints of pathology, bacteriology, the systemic effects on protein and fluid changes, and mortality.

The Role of Glomerular Filtration Rate in the Pathogenesis of Edema

Robert F. Pitts, *Syracuse University*
(Introduced by Eugene F. DuBois)

About 20% of the weight of the body is extracellular fluid, i.e., a balanced salt solution which either circulates rapidly through the vascular system as the liquid blood plasma (about one-quarter of the total) or slowly through the tissue spaces between the cells as interstitial fluid (about three-quarters of the total). The fact that the weight of a normal individual remains constant from day to day despite wide fluctuations in the quantity of salt and water ingested is due to the fact that his kidneys excrete each day just enough of these components of the extracellular fluid to maintain balance. The capacity of the normal kidneys to compensate for fluctuations in intake is remarkable. In heart disease, in kidney disease, in liver disease, and, in truth, in all diseases characterized by weight gain due to fluid logging (storage of excess extracellular fluid as edema) the kidneys exhibit a reduced capacity to compensate for fluctuations in intake, especially of salt. Salt and water are retained and are stored in the highly elastic interstitial fluid compartment.

It is assumed that two disabilities of kidney function account for water and salt retention in edematous states: a deficient formation of a filtrate of the blood plasma in the glomerular tufts (the initial stage of urine formation) and excessive absorption of water and salt from that filtrate as it passes through the kidney tubules. Diuretics used clinically to promote the excretion of edema fluid act by partially blocking this latter tubular absorptive process. Although a few years ago the factor of reduced glomerular filtration was emphasized as a cause of edema, the tendency today is to emphasize tubular overabsorption and even to deny the significance of glomerular filtration.

In animals it is possible to vary glomerular filtration at will by constricting the blood supply to the kidneys and thus reducing the pressure head upon which filtration depends. When filtration is so reduced there is an immediate reduction in the excretion of salt and water. This disability is immediately reversible on removing the constricting clamp. The degree of reduction in filtration

[5] Aided by a grant from the National Foundation for Infantile Paralysis.

rate necessary to produce this disturbance in salt and water excretion is no greater than that which is observed clinically in diseases characterized by edema. It has been observed clinically that in patients who have very low filtration rates, diuretics are relatively ineffective in promoting the excretion of salt and water. In animals, constriction of the renal blood supply reduces the effectiveness of diuretics very greatly. It is concluded that insofar as filtration rate is reduced in disease it will adversely affect the capacity of the kidneys to compensate for fluctuations in salt and water intake and will favor retention as edema. A reduction in filtration rate will also reduce the effectiveness of diuretic agents. It is admitted that reduced filtration rate is only one of several significant factors in fluid retention and resistance to diuretics.

Conference on the Ultracentrifuge

Duncan A. MacInnes
Rockefeller Institute for Medical Research

A group of 21 workers interested in the ultracentrifuge met under the auspices of the National Academy of Sciences for a three-day conference June 14–16, 1949, at the Ram's Head Inn, Shelter Island, Long Island. The program of discussion was arranged around the formula for interpreting ultracentrifuge results:

$$M = \frac{RTs}{D(1-PV)}$$

in which M is the molecular weight of, for instance, a protein, s is the sedimentation velocity, D the diffusion coefficient, V the partial specific volume, P the density of the solution, and R and T the gas constant and absolute temperature respectively.

The determination of s involves problems of centrifuge design. The use of magnetically supported and driven rotors was forecast, and, also, interference methods for following boundary movements.

Great progress was reported in the precision determination of diffusion coefficients, D, by widely differing methods.

The precision of the values of M is largely dependent upon the accuracy of the product, PV, which depends upon density measurements of solutions. A magnetic float method for this determination was reported, as was also a procedure for obtaining the temperature, T, of the rotor while turning at high speeds.

An outstanding result of the conference was the agreement that the trend of research will be away from high speeds, and toward a greater use of equilibrium, as against the sedimentation velocity, method. An important suggestion concerning the utilization of states approaching equilibrium in obtaining molecular weights was advanced.

Some Recent Approaches to the Experimental Study of Human Fatigue

Leonard Carmichael, John L. Kennedy, and Leonard C. Mead, *Tufts College*

The paper briefly reviews some current definitions of fatigue from the standpoint of physiology and psychology. Experimental studies are then reported on the measurement of performance (primarily visual or motor) under various conditions of stress and prolonged work. Among the conditions studied were the following: (1) eye movement and reading accomplishment during six hours of continuous reading; (2) performance of tasks requiring stereoscopic vision, eye-hand tracking, and "lookout" performance, all during three-day period of work with only brief and irregular rest periods; (3) eye movements, various visual tasks, reaction time, steadiness, and certain psychological processes in subjects who worked for fifty hours without sleep; (4) the effect of a three-day sleep deficit on performance in a complex task requiring continuous and simultaneous coordination of several sensorimotor operations.

A generalization which pertains to all the experimental results in the experiments outlined above is that the subjective indices of fatigue are dependent upon the motivation of the individual being studied. This motivation or eagerness or willingness to continue to exert oneself is not a continuous function of the duration of work. Rather, the experiments indicate the presence of high motivation at any stage during the long continued performance of a task will allow the behavior under observation to appear in an essentially unchanged form from that recorded when the subject is "unfatigued."

An electronic apparatus has been developed in an attempt to measure a physiological variable (muscle spike output from the supraorbital musculature) which shows promise as an indicator of the general alertness of subjects while performing tasks during long periods of time. It is tentatively suggested that the early stages of certain states of fatigue in monotonous work may be identified in terms of alterations in the integrated electrical output of muscle spikes from localized muscle areas. There is some evidence that the fluctuations or periodicity noted in this electrical output have a psychological correlate in the temporary blocks in "mental" or physical work which have been observed in our own experiments and in recent experiments by other investigators.

A Hypothesis Regarding the Origin of the Movements of the Earth's Crust

Harold C. Urey
Institute for Nuclear Studies, University of Chicago

If it is assumed that the radioactive content of the core and mantle of the earth are respectively equal to the radioactive content of the iron and stone meteorites, it is found that the earth must be getting warmer. It is assumed therefore that this is the case, that the earth was formed in a cold condition, and that to a first approximation it was a uniform mixture of iron and stony phases throughout, with a possible modification at the center to be mentioned later. Rough calculations show that the gravitational energy stored which would be dissipated in the formation of the present core of the earth is greater than the radioactive heat that has been generated in 2 billion years from all radioactive materials. Kuhn and Rittman have shown that iron droplets cannot sink in the present mantle of the earth because of its high viscosity, but it is maintained here that the iron flows to the center of the earth through channels due to the wetting of some constituent of the stony phase by the iron phase. The

falling of the iron through the mantle generates a large amount of heat, and if there is a sharp layer some distance below the crust of the earth, perhaps at the Rapetti discontinuity, high temperature silicate phase is generated at depth. This leads to convection in the outer mantle of the earth and the formation of mountains, as has been postulated by Griggs. The forces are adequate to account for the formation of mountains and roughly the time of convection estimated is approximately that required by geological evidence, being somewhat too rapid, using a viscosity of 10^{22} poise for the outer earth.

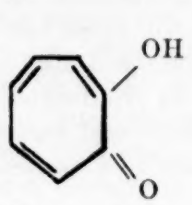
The chemical differentiation in the crust can be explained as separation of olivene from other constituents by sinking in a molten magma at a temperature in the neighborhood of 1500–1600° A. This temperature also is appropriate for explaining the constituents of the atmospheres of Mars, Venus, and the earth on the basis of chemical reactions taking place at this temperature and below. The difference in density of the moon and the earth may be explained if low density material condensed first and higher density material (iron) later. This hypothesis leads to an initial structure of the earth with a core of moon-like material surrounded by a layer of silicate and iron phase. If this central core remained at the center of the earth for some time, then on rising to the surface it should have produced the Pacific Basin, with its floor of basaltic rock. It is interesting to speculate upon what time in the earth's geological history this may have occurred.

Studies on the Structure of Colchicine[6]

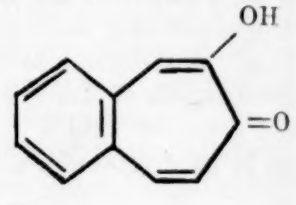
D. S. Tarbell, ***Department of Chemistry, University of Rochester***

(Introduced by W. A. Noyes, Jr.)

The alkaloid colchicine is of biological interest because of its antimitotic action, but its chemical structure is not completely elucidated. Evidence will be presented to support the suggestion of Dewar that colchicine contains the "tropolone" structure (I) in ring C. This evidence



I



II

is based on periodic acid oxidation of hexahydrocolchiceine, and on the study of infrared absorption spectra of colchicine derivatives and other compounds known to contain the tropolone ring. The synthesis of simpler compounds containing the tropolone ring has been studied, and a compound believed to be benztropolone (II) has been obtained by condensation of hydroxyacetone with phthalaldehyde; a by-product in this condensation has been proved to be phthiocol (2-hydroxy-3-methyl-1,4-naphthoquinone). The chemical behavior of II will be discussed in relation to that of the colchicine series.

[6] Aided by a grant from the National Institutes of Health.

TECHNICAL PAPERS

General Method for Paper Chromatographic Analysis of Reducing and Nonreducing Carbohydrates and Derivatives

E. Pacsu, T. P. Mora, and P. W. Kent

Frick Chemical Laboratory, Princeton University, Princeton, New Jersey

The paper chromatographic procedure for the investigation of reducing sugars (*3*, *4*) or their methylated derivatives (*1*, *2*) depends for its success on the ease with which the substances under test will reduce certain inorganic ions at elevated temperatures. It has been found that not all ketosugars or disaccharides will bring about reduction. Efforts have been made to find a more general method of developing chromatograms in order to detect these nonreducing substances. It was proposed by Partridge (*4*) that acidic naphthoresorcinol could be used to detect such carbohydrates. In the course of investigation in this laboratory of complex mixtures of these substances, we have found the use of acidic reagents and of excessive drying undesirable. Experiment showed that excellent results can be obtained by developing the chromatograms with aqueous potassium permanganate (1%) containing sodium carbonate (2%). The chromatograms were removed from the chamber and dried at room temperature, or rapidly at 100° C. By spraying with the permanganate reagent, the bands appeared, with varying rapidity, as striking yellow zones on purple background, even at room temperature. In a short time, as the chromatograms dried, the spots took up their final color as gray regions on a brown background. In view of this change of color, it was expedient to mark the position of each band as soon as it was developed.

Using the partitioning solvents as specified by Partridge (*3*, *4*)—viz., butanol (40%), ethanol (10%), water (50%)—it was possible to separate sugar alcohols, glycosides, and reducing and nonreducing sugars. Attempts to separate acetylated or partly methylated sugars using this modified procedure were not successful, since these substances did not readily reduce permanganate.

In an attempt to obtain a better separation of trisaccharides and the higher sugars, the usual solvent mixture was reversed, i.e., the aqueous layer was used as the eluting solvent in place of the usual butanol layer. Some separation was indeed obtained, but this was ac-

companied by a considerable spreading of the bands. However, some substances, e.g., streptomycin, which were immobile in the Partridge procedure, migrated rapidly and could be readily developed by the permanganate reagent. Further investigation of this approach would be profitable.

TABLE 1

R_f VALUES DETERMINED ON WHATMAN NO. 1 PAPER, USING BUTANOL LAYER AS THE ELUTING SOLVENT (DOWNWARD MIGRATION). TEMPERATURE — 25° C.

Name of compound	R_f value
α-Methyl glucoside	0.35
α-Glucose penta-acetate*	0.969
Mannitol	0.08
Sucrose	0.02
Melibiose	0.009
Lactose	0.013
Melezitose	0.01
Glucosamine	0.052
n-Carbobenzoxy-2-amino-α-methyl glucoside*	0.816
Methyl xylofuranoside	0.449
Salicin	0.526
Turanose	0.042
Potassium glucose-1-phosphate	0.003
D-Ribose	0.269

* Test substance was applied to the paper in ethanolic solution and dried before placing in the chamber.

In Table 1 are shown the R_f values of a series of compounds determined by using potassium permanganate.

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Paper Chromatography of Proteins and Enzymes[1]

A. E. Franklin[2] and J. H. Quastel

Montreal General Hospital Research Institute, Montreal, Canada

The original work of Consden, Gordon, and Martin (*1*) on the paper chromatography of substances of biological importance has been extensively developed, and a large literature has accumulated which cannot be adequately summarized here. So far as we are aware, however, there is no report of the separation of protein molecules by paper chromatography.

We wish to report preliminary results of an investigation of the paper chromatography of proteins and enzymes. Our work shows that it is possible to study the movements of proteins on paper, and to determine the conditions under which proteins may be separated by this means. It is also possible by the same means to bring about separation of the components of enzyme mixtures, and to study enzyme activity, manometrically, on paper.

Our work has been greatly facilitated by the use of hemin as a "marker," the presence of a protein-hemin complex on paper being easily shown by the benzidine-hydrogen peroxide reagent. We employ buffer and aqueous salt solutions, instead of nonaqueous solvents, as developing agents.

The technique employed is that of Williams and Kirby (*2*), which involves chromatography by capillary ascent. Whatman No. 1 sheet filter paper has been used throughout this work. When drying is complete, the paper is streaked with freshly prepared benzidine reagent, using a small paint brush. Color development is immediate and intense, and should be photographed almost immediately, as a background color develops gradually and this tends to obscure the color from the protein-hemin complex.

Protein solutions. Ten mg crystalline protein is dissolved in 1 ml of distilled water or saline and to this is added 0.02 ml of 2.0% hemin, which has been dissolved in 3% sodium bicarbonate solution. Aliquots of 0.01–0.02 ml are used for chromatography.

Developing solutions. A search for suitable developing solutions has resulted in the exclusive use of aqueous solutions of salts and buffers. For buffers, 50 ml of a M/5 solution of the salt is adjusted to the desired pH with a *N*/5 solution of HCl or NaOH and the volume is made up to 200 ml. In the case of acetate-HCl buffers, normal solutions are used. Salt solution concentrations are usually in the region of 1–2%.

The use of organic solvents gave unsatisfactory results. *n*-Butanol saturated with water allowed extremely little movement of proteins and favored the formation of an immediate, deeply colored background on application of the benzidine reagent. Aqueous solutions of ethylene glycol, propylene glycol, ethanol, or acetone induced maximum or near maximum movement. All proteins tested moved about the same distance under these conditions.

Benzidine reagent. The preparation is made as follows: Equal volumes of saturated alcoholic benzidine solution and 3% hydrogen peroxide are mixed and made acid with glacial acetic acid. Fresh reagent must be prepared daily. Poor color development results if the hydrogen peroxide stock solution has decreased in strength.

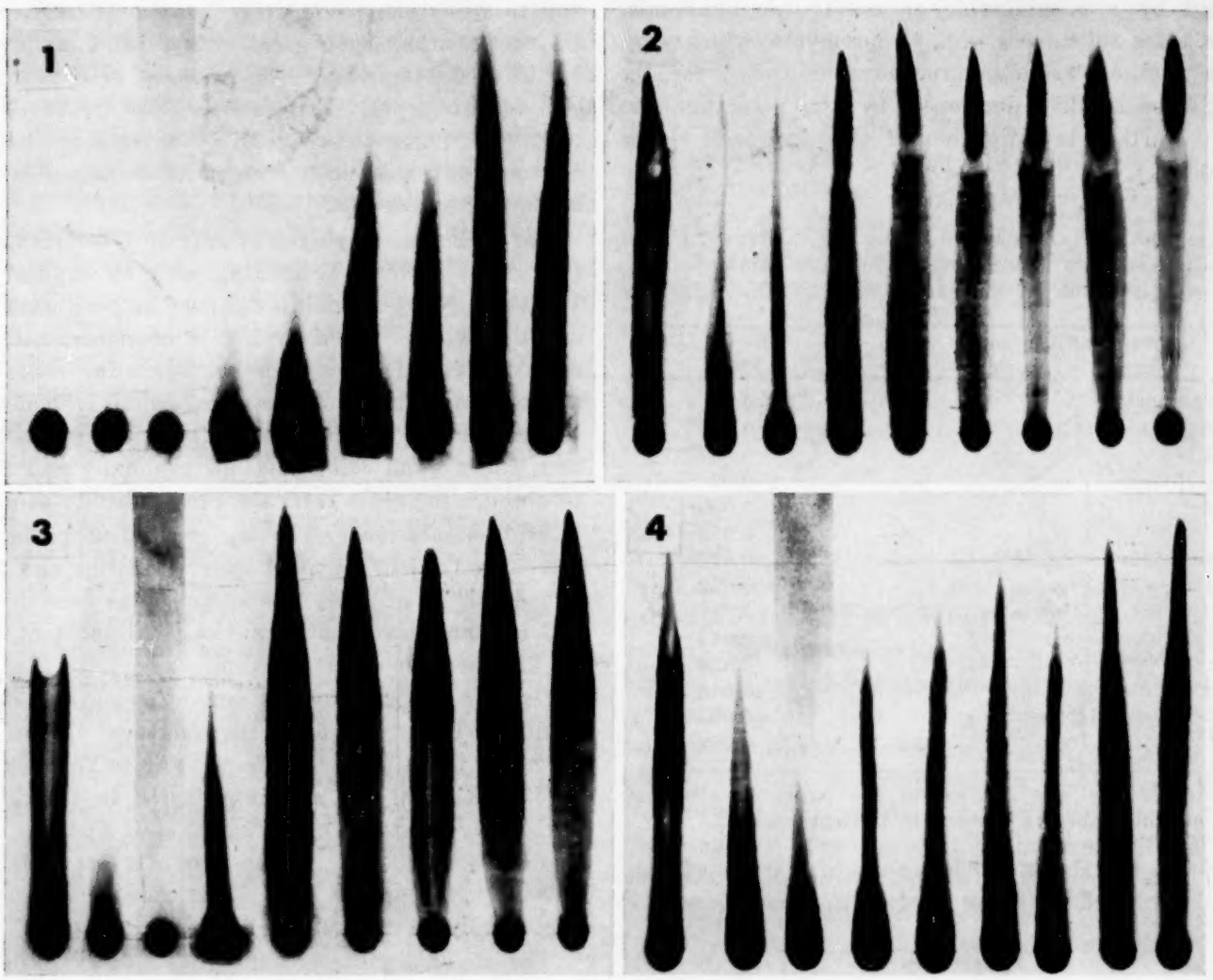
Color development with protein-hemin complexes is generally blue, but may be purple, brown, or green. Some salts, e.g., magnesium sulfate and sodium phosphate, interfere with color development. Citrate, glucose, trisodium phosphate, and potassium hydrogen phthalate at some pH values give rise to a deep purple color.

Background color development varies considerably, depending on the ease with which the benzidine reagent is oxidized. Acid pH values tend to retard background color development, while alkaline pH values give rise to a deeply colored background. Photographs are made of the chromatograms at the optimal development of color. It is necessary to photograph the chromatogram while the paper is still damp.

Hemin. A stock solution of 2% hemin in 3% sodium bicarbonate solution was prepared and 0.02 ml was added to 1 ml of the protein solution. In the proteins studied,

[1] Aided by a grant from the National Cancer Institute of Canada.

[2] Holder of a Canada Packers Research Fellowship of McGill University.



FIGS. 1–4. Composite photographs of unidimensional chromatograms of hemin and protein-hemin mixtures, showing the effects of changes of pH from 2 to 10 at 1-pH-unit intervals, from left to right. 1. Hemin control. 2. Bovine serum albumin-hemin. 3. β-Lactoglobulin-hemin. 4. γ-Globulin-hemin.

it has been observed that the presence of hemin does not alter the R_f value of the protein.

A control hemin chromatogram, in which 0.02 ml is diluted to 1 ml with distilled water, shows that movement is nil up to pH 5 and very slight at pH 6, and that it increases considerably above this pH (Fig. 1). Some developing solutions, among them those containing bicarbonate, glucose, sucrose, glycine, methionine, alanine, and urea, allow maximum or near maximum movement.

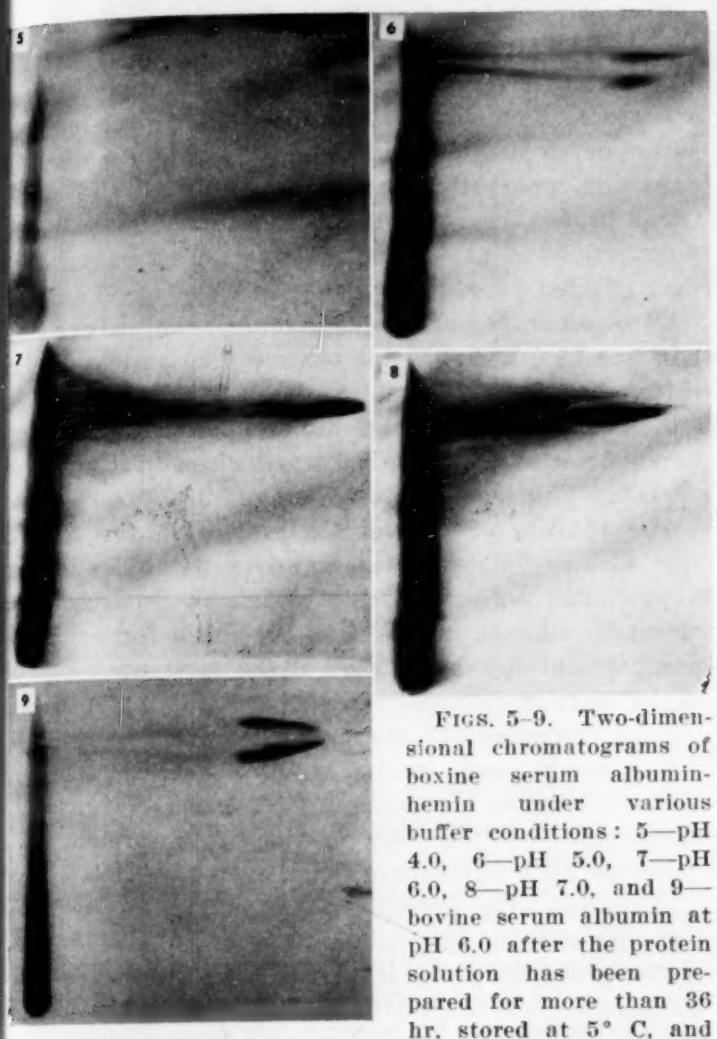
It has been found that some proteins and protein mixtures such as egg albumin, pepsin, papain, diastase, and urease will not combine with hemin. However, if hemin is added to a solution of these proteins, chromatographed, and streaked with the benzidine reagent, it is noticed that hemin remains at or near the point of origin (below pH 7). If the paper is allowed to stand for some time at room temperature, it is found that the background will color (to varying degree, depending on the nature of the salt in the developing solution), and a colorless spot will appear. It will be shown later that this colorless region actually contains the protein. Presumably the protein retards background color development and so produces a colorless "spot." Casein and β-lactoglobulin give rise to colorless spots or fractions up to about pH 5, and to deep blue fractions at higher pH values. γ-Globulin and bovine albumin give rise to colored fractions over the entire pH range (see Figs. 2, 4).

Time of development. It has not been found necessary to allow the solution front to advance beyond 20–25 cm, which requires about 90 min. The composition and shape of the chromatogram is determined within the first 20 min, and further development results in a more easily evaluated fraction. A complete two-dimensional chromatogram may be obtained within 5 hr.

The protein chromatogram. A long, rather narrow finger is formed, provided that the protein combines with hemin. The color intensity varies along with the finger, depending on the pH with which it is developed. Bovine albumin-hemin at pH 2 shows two intensely colored fractions inside the finger (Fig. 2). It may be shown that the greatest portion of the protein is concentrated in the leading fraction, and only traces remain in the finger.

One-dimensional chromatography results in the formation of a yellow-colored solution front, which fluoresces in ultraviolet light, and at pH 2, two separated bands appear at the leading edge of the chromatogram. Two-dimensional chromatograms result in a series of villus-like structures appearing in the second dimension. The presence of proteins on the paper tends to repress the full movement of those structures that are in the immediate vicinity of the protein.

Effect of pH. The variation of protein movement with change of pH seems to be much the same for all the proteins studied. At very acid pH values, e.g., pH 2, there



FIGS. 5–9. Two-dimensional chromatograms of boxine serum albumin-hemin under various buffer conditions: 5—pH 4.0, 6—pH 5.0, 7—pH 6.0, 8—pH 7.0, and 9—bovine serum albumin at pH 6.0 after the protein solution has been prepared for more than 36 hr, stored at 5° C, and then chromatographed with citrate in the first dimension and fumarate in the second dimension.

usually appears a well-defined leading section. In the region of pH 4–5 there is often little or no movement, and where movement does occur, no well-defined leading fraction occurs. Above this pH, a large, well-defined spot appears, which is quite constant in size. The R_f values depend upon pH in a similar way, being least around pH 4, which is near the isoelectric point of some of the proteins. R_f values and sizes of the spot are remarkably constant from pH 6 upwards.

Chromatography of bovine serum albumin-hemin complex. The R_f value of a bovine albumin-hemin complex is least in the region of pH 4. At pH 2, there appear two separated fractions inside the finger. This is also true at pH 3 but the spots are smaller and less intensely colored. From pH 5–12, there is a well-defined leading fraction, quite constant in size and position (Fig. 2).

In two-dimensional chromatograms, at pH 4, there is movement in the first dimension only (Fig. 5). At pH 5, with citrate-NaOH in the first dimension, and phthalate-NaOH in the second dimension, two separate fractions are obtained (Fig. 6). At pH 5.5 with citrate-NaOH in the first dimension and acetate-HCl in the second dimension, there appear two main fractions and a minor fraction. At pH 6 and 7 there is a single fraction appearing in the second dimension (Figs. 7 and 8).

It has been observed that if bovine serum albumin is allowed to remain in solution for a period of more than 36–48 hr, multiple fractions, sometimes as many as four, will appear. Various combinations of buffers have shown the separation of these fractions at pH 6 (Fig. 9).

It is apparent from these results that the crystalline bovine albumin which we have used behaves, when a solution is freshly prepared, as a homogeneous protein at pH 6–7, whereas two components are present at pH 5–5.5.

A private communication from Dr. G. Perlmann, to whom we are indebted for our supply of crystalline bovine serum albumin, states that this protein is homogeneous electrophoretically from pH 3.0 to 3.8 and pH 5.0 to 10.0. In the region of the isoelectric point the protein separates into two distinct electrophoretic components. This phenomenon seems to be a property of most serum albumins and indicates that crystalline albumin preparations contain several closely related proteins. Paper chromatography appears to confirm and may extend the results of electrophoretic analysis.

Chromatography of β-lactoglobulin-hemin complex. It is found that the union between β-lactoglobulin and hemin is not complete if the pH is 5 or less, i.e., the leading fraction is colorless. From pH 6 upwards, the complex shows as an intense blue. Thus the formation of a complex between this protein and hemin is dependent upon pH. R_f values show much less variation than those of bovine albumin. The R_f value is least at pH 4 and greatest at pH 6, where it is 0.86. All other values lie very close to 0.80 (Fig. 3).

Two-dimensional chromatograms between pH 6 and 7 demonstrate that this crystalline protein is not homogeneous. The use of citrate-NaOH in the first dimension and tartrate-NaOH, phthalate-NaOH, or acetate-HCl in the second, shows that there are a number of fractions in this sample. However, their complete separation under these conditions has not yet been achieved (Fig. 10).

We are again indebted for this sample of protein to Dr. Perlmann, who states that in 1945 this protein was found to be a mixture, there being two distinct electrophoretic components in the pH range 3.7–5.0, and also between pH 6.0 and 7.0.

Chromatography of human γ-globulin-hemin complex. It appears that γ-globulin, at the concentrations used, does not combine completely with hemin over the entire pH range. At each pH value, some combination takes place, but it is evident that from pH 3 to pH 8, there is a portion that does not combine, the amount of this portion decreasing with an increase in pH.

At pH 2, γ-globulin gives rise to two separate fractions inside the finger, in much the same manner as that shown by bovine albumin, but the fractions are smaller in size. Movement is least at pH 4. R_f values are 0.78 at pH 2.0 and 7.0, and increase to 0.81 at pH 10 (Fig. 4).

A two-dimensional analysis shows an excellent separation of two components of γ-globulin, the separation occurring at right angles. The first developing solution may be a phthalate-NaOH buffer at pH 6.0, 5% ammonium sulfate or 2% oxalic acid, followed by 2% tartaric acid in the second dimension (Fig. 11).

This protein, according to Dr. G. Perlmann, who kindly provided the sample, consists of one main electrophoretic component (96% of the total protein content), and it shows a marked boundary spreading, which indicates lack of homogeneity.

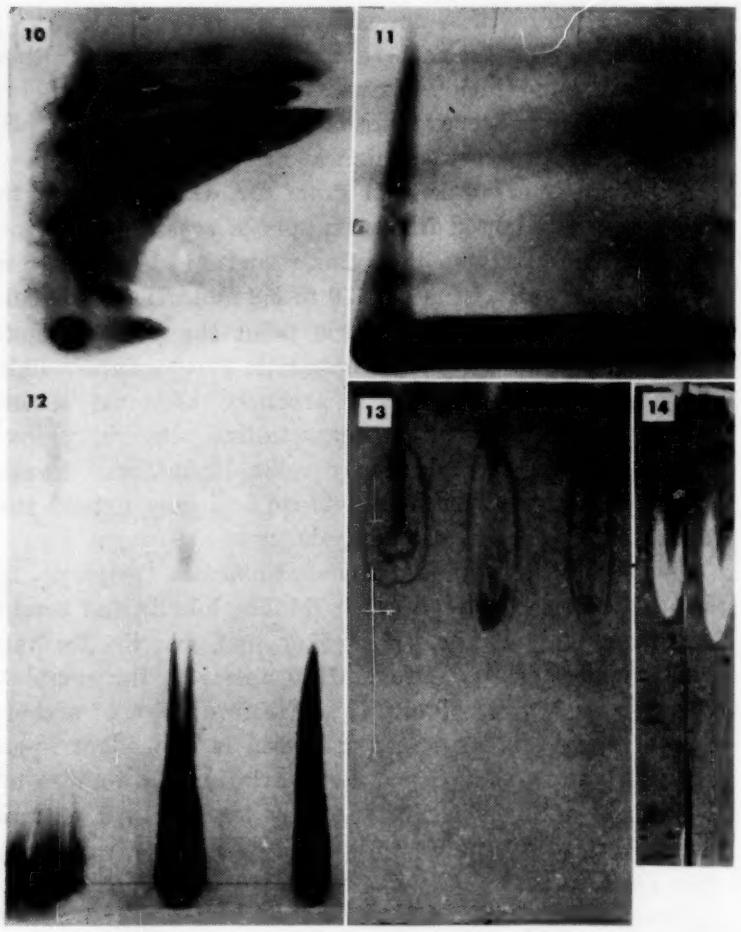


FIG. 10. Two-dimensional chromatograph of β-lactobulin-hemin at pH 6.5.

FIG. 11. Two- dimensional chromatogram of γ-globulin-hemin, using a phthalate buffer at pH 6.0 in the first dimension, followed by a 2% tartaric acid in the second dimension.

FIG. 12. Papain, papain-casein, and casein, in that order, developed with 2% succinic acid as the developing solution.

FIG. 13. Papain-bovine serum albumin, diastase-β-lacto-globulin, and β-lactoglobulin developed in a phthalate buffer at pH 5.0. There is no separation.

FIG. 14. Egg albumin developed in distilled water at pH 6.4. The resulting white spot was eluted, and identified by serological means.

Chromatography of enzyme preparations. Some preliminary work has been done on the movement of enzyme solutions. Preparations of pepsin, papain, malt diastase (commercial preparations from British Drug Houses, Ltd.) and urease (25-mg Urease-Dunning tablets) were used, and it was found that hemin will not combine with any of them. After streaking with the benzidine reagent and allowing the paper to stand for a time, it is observed that the malt diastase and papain preparations give rise to very well-defined, colorless oval spots. The urease preparation produces a vertical streak, but the pepsin preparation fails to show any definable movement. The papain preparation shows R_f values of 0.81 up to pH 3, which increase to 0.90 at pH 8.0–12.0. The malt diastase preparation shows a very constant R_f value over the entire pH range, varying only between 0.90 and 0.95, whereas the urease has an R_f value of 0.78 at pH 2, which increases to 0.85 at pH 3 and then gradually increases to 0.92 at pH 12. It seems likely that paper chromatography will be of service in the evaluation and examination of commercial enzyme preparations.

Chromatography of mixtures of proteins. One-dimensional chromatograms rarely separate a pair of proteins. We have succeeded, however, in separating components of a mixture of papain and casein, using 2% succinic acid as the developing solution (Fig. 12). The movement of papain is apparently retarded by the presence of casein. Other proteins have been run in combination with the preparations of papain and diastase, but no separations were effected (Fig. 13).

Chromatography of egg albumin. Crystalline egg albumin was used and, like the enzyme preparations already referred to, it will not unite with hemin. It appears as a colorless spot on a colored background (Fig. 14). It is barely detectable below pH 4, at which point it has an R_f of 0.60. This increases to 0.75 at pH 9.

The identity of the protein present in the colorless spot with egg albumin was shown by its ability to form a precipitin with a specific antiserum produced in a rabbit by albumin injections.[3] Precipitin formation was produced only by the solution of the substance contained in that part of the paper strip believed to contain the protein, as determined by the streaked control.

Our results prove that a solution of crystalline egg albumin may be chromatographed under the given experimental conditions, the position of the protein being indicated by a well-defined colorless region on a colored background. The protein present in this region reacts typically with an ovalbumin antiserum.

Chromatography of a urease preparation and the manometric estimation of urease on paper. The question arose as to whether enzymes will retain their catalytic activities if they are subjected to our chromatographic technique. A series of chromatograms was therefore set up for this purpose, the enzyme selected being urease.

The enzyme solution was prepared by grinding twenty 25-mg urease-Dunning tablets in a small mortar in 2 ml of a 2% cystein-glycine solution that had been adjusted to pH 6. It was then centrifuged for 15 min, and the supernatant solution was used for chromatography. Aliquots of 0.04 ml were applied to the paper by placing 0.02 ml on the paper, allowing it to dry, and adding another 0.02 ml. The developing solution was prepared by dissolving 2 g cystein hydrochloride in water and adjusting the pH to 6 with caustic soda solution, making the volume to 100 ml, and then adding 1 g glycine. This reagent should be prepared just prior to use. The solution was allowed to advance about 20–22 cm. The paper was then removed and allowed to stand at room temperature for a few min. While the paper was still damp, it was cut into 3-cm sections, starting 0.5 cm from the bottom of the paper. The boundaries were marked 7 mm on each side of the point of application of the aliquot.

Each section of filter paper was then cut into four parts, all of which were placed immediately in a Warburg manometric vessel with 3 ml acetate buffer at pH 5, and 0.2 ml 10% urea was placed in the side arm. As a control, a ten times dilution of the original supernatant was

[3] This antiserum was kindly prepared for us by Prof. E. G. D. Murray, of the Department of Bacteriology, McGill University.

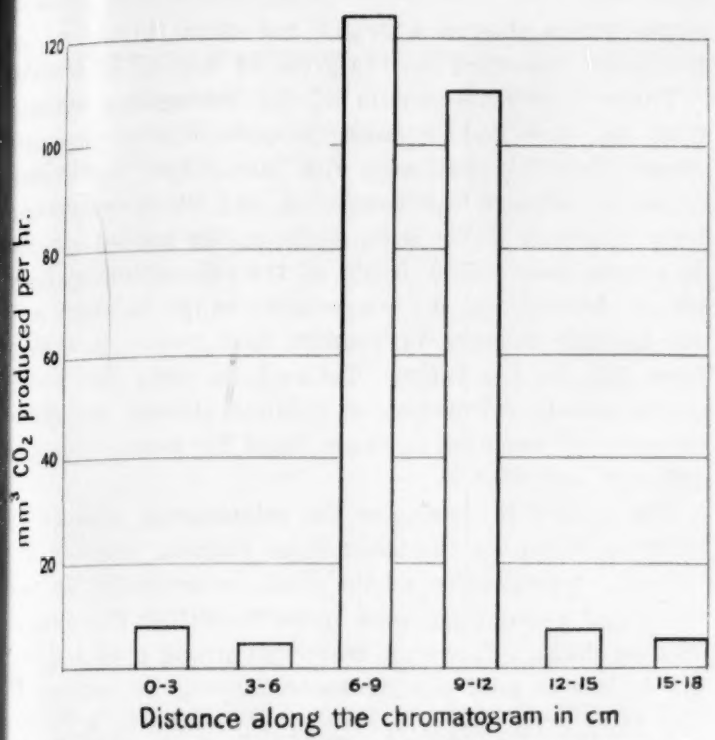


FIG. 15. Urease activity along the chromatogram.

used (diluted with physiological saline) and 0.4 ml of it placed in the Warburg vessel with 2.6 ml buffer and 0.2 ml 10% urea in the side arm. A period of 30 min was allowed for the contents of the vessel to attain thermal equilibrium (37° C). The urea in the side tube was then tipped into the vessels, and carbon dioxide output rate measured manometrically in the usual way for 1 hr.

The results show the existence of a distribution curve of urease on the paper strip. Traces of enzyme are left at the point of origin, but a fair proportion ascends the paper, whose maximum urease activity lies between 6 and 12 cm from the origin. On either side of the maximum there is a drop in enzymic activity. These results are shown in Fig. 15. If a parallel chromatogram is streaked with the freshly prepared benzidine reagent, it is found that the greatest extent of the colorless region on the colored background is 6–12 cm from the origin.

On assessing the activity of the urease over the entire strip, by adding together the activities of the various parts of the strip it is found that the total activity amounted to 85% of that expected from the amount of urease placed on the paper. Another assessment of the total urease activity over the entire strip showed a recovery of 110%, the assessment being made from a calibration curve previously prepared, relating activity (rates of CO_2 production) to the quantity of urease. These results show that urease activity is not diminished within experimental error by our chromatographic technique, and that movement of the urease molecule on filter paper can be followed. It is evident, however, from our preliminary results that metallic constituents of the filter paper may appreciably affect the rate of movement of urease and possibly other proteins. This needs more study.

Chromatography of human serum. A few experiments have been carried out on the chromatography of human serum. The results show the presence, at pH 6, of a complex mixture of hemin-reacting proteins. Three of the fractions appear to give R_f values identical with those found with a preparation of crystalline human serum albumin. Human serum globulins do not seem to move appreciably in the second dimension. We estimate that, with our technique, between 6 and 10 protein fractions appear. This work is now being extended with a view to discovering whether paper chromatography of blood serum may be used for diagnostic purposes.

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Tetrazolium Chloride as a Test for Damage in Artificially Cured Peanuts

H. E. Brewer[1]

Department of Botany and Plant Pathology, Alabama Polytechnic Institute, Auburn

The artificial curing of peanuts is being investigated in several Southeastern states as one phase of a mechanization program designed to reduce production costs and improve nut quality. Drying methods found to be practicable for certain other oil crops and for cereal crops could not be applied empirically to the peanut because of the uncertainty of curing effects upon flavor of nuts for the food trade and because of the heat- and moisture-insulating properties of the peanut shell. Large scale experiments on artificial curing of peanuts, therefore, have had to await results of preliminary trials.

In a series of exploratory curing tests at the Alabama Agricultural Experiment Station, using different drying temperatures and rates of air flow, the desirability of a quick test of curing effects upon peanut quality soon became apparent. It was evident that the standard tests of quality in sound, mature peanut kernels—free fatty acid percentage, iodine value, and germinability—all required more time and analytical apparatus than were practical for rapid estimates of heating effects upon peanuts. Furthermore, germinability could be used at time of harvest only for the Spanish variety of peanut. The runner variety, which constitutes the great bulk of the Alabama crop, germinates only after a period of dormancy of several weeks following harvest.

However, it was assumed that seed viability might be correlated with some of those properties of flavor and oil quality which characterize peanuts of high market value both at time of harvest and after storage. Successful use of tetrazolium salts as viability stains in seed germination experiments (*2, 3, 5, 7*), in determination of vitality in miscellaneous plant and animal cells and tissues (*6*), and in demonstration of injury by heat in stem tissues (*8*) and by freezing in maize (*1, 4*) suggested their possible application as a quick test for heat and drying damage in artificially cured peanuts. Preliminary results indicate that they may be so used.

[1] Present address: Department of Botany, State College of Washington, Pullman, Washington.

TABLE 1

EFFECT OF HEATING UNSHELLED SPANISH PEANUTS FOR 1 HR AT VARIOUS TEMPERATURES UPON VITALITY AS SHOWN BY TETRAZOLIUM CHLORIDE AND GERMINABILITY TESTS

Temperature of treatment °F.	Degree of injury shown by tetrazolium vitality test				Germinability
	Killed	Serious damage	Slight damage	Undamaged	
	%	%	%	%	%
115	0	0	3	97	92
130	0	0	4	96	93
145	0	0	4	96	92
150	0	2	8	90	81
155	4	69	21	6	46
160	100	0	0	0	0

The peanut seed is exceptionally well suited to the vitality stain technique. Porter *et al.* (*7*) pointed out the practical difficulty of interpreting vitality stain tests in some other leguminous seeds because the large, thick cotyledons are stained along with the rest of the embryo, thus requiring more time and care for making a separate analysis of the radicle and plumule. The peanut is unlike other common leguminous seeds in that the torpedo-shaped "germ" (embryonic axis including plumule, hypocotyl, and radicle) is quite readily detached from the cotyledons without overnight soaking or other preliminary treatment. Also, the plumule is well developed in the mature peanut seed, permitting more accurate prediction of normal shoot development than is possible with seeds of such legumes as soybeans (*7*).

Investigators (*2*, *3*, *5*, *7*) have recommended soaking the seeds of other legumes in water for several hours or overnight before testing, and immersing them in the tetrazolium salt solution for several more hours before analyzing them. An accelerated test modified after Cottrell (*2*) was used for the peanut experiments described in this paper, in which the separated embryonic axis was held in warm water (115° F) for an hour, then immersed in a 2% solution of 2,3,5-triphenyl-tetrazolium chloride and incubated in the dark at 115° F for another hour, after which readings were made.

Following such treatment, the germs from green or naturally dried peanuts give a bright red stain to the plumule, as well as to the entire cross section of the interior of the hypocotyl and radicle. The surface cells of the hypocotyl and radicle show only light staining or none, but the heavily stained interior is plainly visible through them. In interpreting heating effects of artificial curing upon the peanut kernels in these studies, four criteria of staining were considered indicative of four degrees of damage. An unstained germ was judged to be evidence of complete killing. An unstained plumule of a germ, which otherwise showed red or pink coloring of the interior of radicle and hypocotyl, was considered to indicate serious heat damage. A pale red or pink staining of both plumule and radicle was interpreted as showing medium to slight curing damage. Peanuts undamaged by the artificial curing were believed to be those whose germs showed a bright red stain throughout, as previously described for the green or field-cured peanuts.

Table 1 presents results of the tetrazolium staining tests on unshelled Spanish peanuts (initial moisture range 22–25%) that were run immediately after each drying experiment was completed, and the corresponding tests of germinability were made on like peanut samples at a later time. The utility of the tetrazolium staining test in determining the temperature range in which serious heating damage in peanuts first occurs is evident from data in the table. Tetrazolium tests and germination counts for untreated peanuts showed essentially the same percentages as those listed for temperatures of 115, 130, and 145° F.

The studies to determine the relationship between vitality as shown by the tetrazolium staining reaction and chemical deterioration of the seeds, as indicated by free fatty acid percentage, were inconclusive for the number of tests made. However, there was strong evidence that the decline in seed vitality accompanying an increase in free fatty acids can be accurately estimated by a further refinement of the tetrazolium technique. It also has been shown by the author in other experiments, results from which are to be published elsewhere, that the first marked increase in the percentage of such undesirable physical properties of peanuts as slipping of skins and breaking of kernels during shelling appears in essentially the same temperature range (150–160° F), which has been shown here to be associated with the first rapid loss of viability. It therefore appears that the tetrazolium test may be used as an indirect measure of heating effects upon biological, physical, and chemical properties of peanut seeds.

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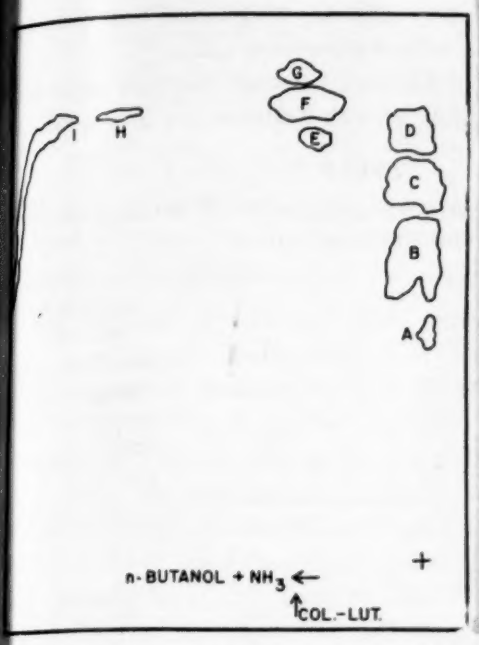
Radioiodine and Paper Chromatography Technique in the Study of Thyroid Metabolism[1]

Garson H. Tishkoff, Robert Bennett, Vera Bennett, and Leon L. Miller

Department of Pathology and Department of Radiation Biology, University of Rochester School of Medicine and Dentistry, Rochester, New York

Preliminary studies in this laboratory employing the procedure of Fink, Dent, and Fink (*3*) with radioiodine and paper partition chromatography have indicated that several of the radioiodine products of unknown nature

[1] Based in part on work under contract with the AEC, University of Rochester, Atomic Energy Project.



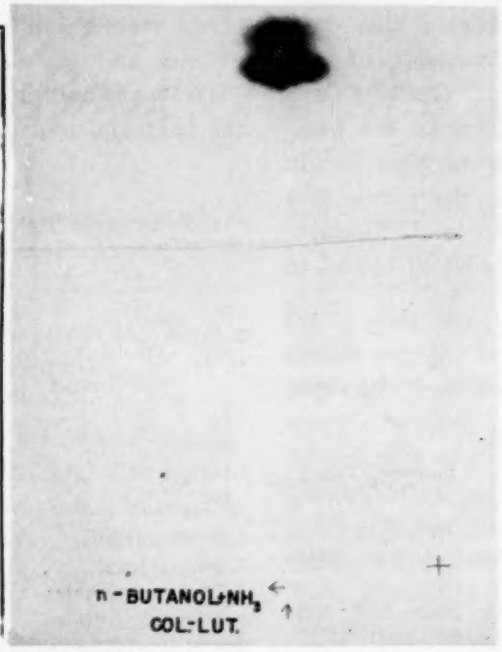


FIG. 1. Distribution on paper chromatogram of iodine-containing constituents obtained from thyroid hydrolyzate: A, unknown; B, diiodotyrosine; C, monoiodotyrosine; D, unknown; E, thyroxine; F and G, iodide; H, diiodothyronine (?); and I, unknown.

FIG. 2. Radioautograph of paper chromatogram run on NaI^{131}.

FIG. 3. Radioautograph of paper chromatogram obtained from alkaline hydrolysis of thyroid gland (48 hr following injection of NaI^{131}).

previously reported in thyroid hydrolyzate as well as the solvent artifact may have arisen from the interaction of radioiodide and the phenol solvent employed. This paper reports the results of a series of experiments aimed at characterizing the iodinated products of thyroid hydrolyzate using a paper partition procedure modified to avoid the interaction of radioiodide and the solvents employed.

The use of two-dimensional paper partition chromatography in conjunction with radioiodine in the study of thyroid metabolism has demonstrated the presence in thyroid hydrolyzates of thyroxine, mono- and diiodotyrosine, and several compounds of undetermined nature (*3*, *4*). Hird and Trikojus (*5*) have demonstrated the presence of thyroxine, diiodothyronine, and possibly triiodothyronine as ninhydrin-reactive products from the hydrolyzate of thyroprotein, using one-dimensional paper partition technique and a solvent consisting of an ammoniacal mixture of *n*-butanol and amyl alcohol.

Rats were given subcutaneously 50 μc of carrier-free I^{131} and sacrificed at 24, 48, and 72 hr. Thyroids were hydrolyzed with 8% $Ba(OH)_2$ for 24 hr in a sealed tube, the excess barium was removed by bubbling CO_2 through the solution, and the supernatant was placed directly on the filter paper. The precipitate was then extracted once with *n*-butanol and the filtrate placed on the paper over the previous spot. Approximately the equivalent of one thyroid gland was used for each paper chromatogram.

In the preparation of the two-dimensional chromatogram, *n*-butanol in an atmosphere of NH_3 was employed as one solvent, and a mixture of collidine and lutidine as the second solvent. Before use, all solvents were treated with a large excess of elementary iodine and then distilled to remove the resulting iodine-reactive products. The filter paper employed was Schleicher and Schuell analytical paper No. 589. The ascending technique of Williams and Kirby (*6*) was employed for the *n*-butanol solvent and the descending technique (*1*) for the collidine solvent. Radioautographs[2] were prepared from the chromatograms in the conventional manner and the paper chromatograms were then developed with ninhydrin to demonstrate the presence of amino acids on the paper.

A diagram showing the radioactive substances in the hydrolyzate is shown in Fig. 1. Spots B and E correspond exactly with ninhydrin spots of 3,5-diiodotyrosine and thyroxine[3] respectively when these substances were added to a control paper. Radioiodide appears on the paper chromatogram as a double spot G and F and these were the sole spots observed with the purified solvents employed (Fig. 2). Spot C was routinely observed as a strong radioactive spot and corresponds in position to monoiodotyrosine as reported by Dent (*2*), the occurrence of which was also shown by Fink and Fink (*4*). Spot H has not been identified but corresponds in position approximately to diiodothyronine, as previously reported (*5*). Spots A and D are unknown iodine-containing substances which appear very faintly, but only A reacted with ninhydrin. Spot I has been consistently observed in all thyroid hydrolyzates and is also of unknown nature.

Fig. 3 shows a radioautograph prepared from a chromatogram of a thyroid hydrolyzate; the thyroid had been dialyzed exhaustively against cold water prior to hydrolysis. The presence of the characteristic iodide double spot indicates that free iodide is formed during alkaline hydrolysis or that the thyroid gland contains undialyzable iodide, possibly in bound form. Mono- and diiodotyrosine appear as strong spots, whereas thyroxine is relatively weak. The radioactive spot remaining at the origin is most likely a small residue of BaI_2, since in other similar

[2] We are indebted to Mr. Robert Hay for the preparation of the radioautographs.

[3] We wish to thank Dr. D. P. Wallach for a generous sample of thyroxine isolated from iodinated casein.

studies careful removal of barium eliminated this spot and did not significantly alter the remainder of the chromatogram. Simple extraction of thyroid glands with collidine-lutidine revealed in the extracts the presence of radioactive spots corresponding to free iodide and mono- and diiodotyrosine, but no thyroxine was detected. This would indicate that mono- and diiodotyrosine exist in free form and are not completely bound to protein.

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The Effects of Antagonists on the Multiplication of Vaccinia Virus *in Vitro*

Randall L. Thompson, Marian L. Wilkin, George H. Hitchings, Gertrude B. Elion, Elvira A. Falco, and Peter B. Russell

Department of Microbiology, Indiana University Medical Center, Indianapolis[1] and *The Wellcome Research Laboratories, Tuckahoe, New York*

A large series of analogues og purine and pyrimidine bases and related substances (*6–9*) have been tested for their ability to interfere with the multiplication of vaccinia virus in tissue culture. The method described by Thompson (*11*) measures the multiplication of the virus in the presence and absence of added substances. The inhibitory effects of substituted amino acids (*11*) and of a phenylalanine analogue (*12*) have been reported.

In the general field of substances which might be expected to interfere with nucleic acid synthesis, many substances diminish the rate of multiplication of the virus virus during the incubation period, thus having an ap- and a few bring about a diminution in the titer of the parent virucidal activity.

In many instances the activities of the analogue on vaccinia virus bear a close resemblance to those on *Lactobacillus casei* (*6, 9*). Thus among the substances structurally related to thymine, 5-bromouracil, 5-nitrouracil, dithiothymine, and isobarbituric acid give small but significant and reproducible inhibitions (Table 1). Certain amides of aminouracil, such as 5-*p*-nitrobenzamidouracil, show similar activity. 2,6-Diaminopurine exhibits strong inhibitory effects, which are reversible by purines and nucleic acid derivatives (*13*).

One outstanding difference between vaccinia virus and the bacterial and other growth systems lies in the failure

TABLE 1

Influence of Pyrimidine Analogues on Multiplication of Vaccinia Virus

Compound	Conc. mg/ml	Increase in virus titer (logarithm 50% end point)	
		Control	Treated
5-Bromouracil	0.1	2.10	1.70
5-Nitrouracil	0.1	2.20	1.80
5-Hydroxyuracil	0.1	2.20	1.36
2,4-Dithiothymine	0.1	1.96	1.48
5-*p*-Nitrobenzamidouracil	0.1	2.30	1.67
2,6-Diaminopurine	0.05	1.30	−0.69
2,4-Diamino-5,6-dimethylpyrimidine	0.05	1.55	1.59
	0.1	1.55	1.14
4-Aminofolic acid	0.1	2.51	1.92

of folic acid antagonists to show more than minimal inhibitions of the virus. This applies not only to the simpler bases, such as 2,4-diamino-5,6-dimethylpyrimidine, which exhibit antifolic activity in the bacterial systems (*8*), but also to the structural analogues of pteroylglutamic acid (PGA) such as 4-aminofolic acid, as shown in Table 1. The inhibitory effects of the structural analogues of PGA are evidenced in many biological systems which involve the rapid proliferation of cells (*2–4*). In general, diaminopurine has been found to have similar effects (*1, 5, 8*). However, a different locus of action of the two antagonists (*6*) is indicated by reversal studies (*6, 8*), and by the hematological findings (*10*). A possible explanation of the present studies might be that the proliferation of the virus occurs via a pathway which is blocked by diaminopurine but not by the folic acid analogues.

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[1] Parts of this program were carried out at Western Reserve University Medical School during 1945 and at the Medical College of Virginia 1946–7.

Book Reviews

Philosophy of mathematics and natural sciences. Hermann Weyl. Princeton, N. J.: Princeton Univ. Press, 1949. Pp. x + 311. $5.00.

Philosophers of science have long admired Weyl's "Philosophie der Mathematik und Naturwissenschaft," which appeared in Oldenbourg's *Handbuch der Philosophie* in 1927; they have also regretted its unavailability. The present volume is in part a translation of that classic work with its penetrating analysis of the philosophic foundations of arithmetic and geometry, and its clear formulation of the concepts of space, time, and relativity. The translation is ably done by Olaf Helmer and Joachim Weyl, the author's son. In addition, the book contains 80 pages of new material in the form of six appendices, the quality of which elevates this work to a unique rank in its field today.

With respect to subject matter, the appendices cover the most important topics of scientific methodology (the effects of Gödel's theorems on the structure of mathematics, quantum physics and causality, physics and biology). Their attractiveness is greatly increased, however, by the author's philosophic frankness, by his clear statements of the motives for his selection. Up to 1926, the continuous, extensive medium of space and time stood in the center of philosophic thought. Meanwhile, the discontinuous combinatorial structures of quantum theory, its concern for symmetries, have become increasingly significant. In view of this change, the new portions of the book attack "ars combinatoria" on a very basic plane and show its relation to several of the theories of modern physics. A new point of view is brought to bear upon the problem of chemical valence, and the only regret one might feel in reading Appendix D, which deals with it, is that the elegant treatment is so condensed as to leave it beyond the grasp of many workers in the field.

HENRY MARGENAU

Yale University

History of the primates: An introduction to the study of fossil man. W. E. Le Gros Clark. London: British Museum (Natural History), 1949. Pp. 117. (Illustrated.) 2s 6d.

That well-served character, the intelligent layman, will find here an answer to almost any reasonable question on present knowledge of the ancestry of man. The discussion is scientific in the best sense but is thoroughly readable and nontechnical. From the general principles of evolution and of classification through the fossil and recent lower primates to fossil man and the rise of *Homo sapiens*, the treatment is amazingly complete for so short a book, phrased in such easily comprehensible terms. Its excellent balance, its cautious and fair presentation of controversial points, and its inclusion of the most recent discoveries and studies make this surely among the best and perhaps quite the best available work on the subject for the layman.

The more professionally interested reader will be specially concerned with Professor Le Gros Clark's comments on the crucial and disputed episodes in human phylogeny. Although no one has better right to opinions on this subject, he presents the issues fairly and without ex-cathedra edicts, but he does quite properly weigh the probabilities.

The higher primates are suggested to have arisen from some of the more advanced Eocene tarsioids, rather than from lemuroids or less clearly differentiated prosimians. The hominoid group (including both apes and men) is believed to have had an independent origin among the tarsioids and not to have passed through a cercopithecoid stage. All the hominoids are indicated as having a common, ultimately monophyletic origin among unspecialized, mid-Tertiary apes from which arose the specialized recent apes, on one hand, and the hominids, on the other. Evidence for this degree of affinity of apes and men is seen among the generally primitive Miocene apes, still typified by *Dryopithecus*, although the group is now known to have been rather highly diverse and to have included, for instance, such forms as the somewhat chimpanzee-like *Proconsul*.

The South African Australopithecinae are stressed. The vexatious question of their generic and specific classification is evaded, and their essential common characters are described and illustrated without specification as to the several supposedly distinct types. The australopithecines as a group are regarded as closely related to man, either as direct ancestors or as little-modified survivors of an ancestral stock.

Pithecanthropus (including *Sinanthropus* as a synonym) is also considered directly ancestral to later hominids. It is suggested that descent from *Pithecanthropus* occurred in two different lines, one leading to the neandertaloids as a distinct, specialized offshoot that became totally extinct, and the other leading through such forms as the Swanscombe, Steinheim, and Ehringsdorf men to modern man, *Homo sapiens* strictly speaking.

Each of these phylogenetic decisions invites discussion and all will be disputed by one student or another. This is not the place to argue them, and the author continually emphasizes that they are matters of opinion in a field where too many of the facts still elude us.

The book contains no restorations of prehistoric men or other fossil primates and is not provided with a graphic phylogenetic tree. Most of the illustrations are factual drawings of living animals or of known fossil remains. The farthest departure from this objectivity is a diagram of the questionable Milankovitch-Zeuner chronology of the Pleistocene, and the provisional nature of this is duly noted.

This is a well-written, sound, modest book for which

we should be duly thankful. Wide distribution in the United States of this or of a comparably inexpensive American edition would be highly desirable.

GEORGE GAYLORD SIMPSON
American Museum of Natural History

Elmtown's youth: The impact of social classes on adolescents. August B. Hollingshead. New York: John Wiley; London: Chapman & Hall, 1949. Pp. x + 480. $5.00.

Social class in America: A manual for the measurement of social status. W. Lloyd Warner, Marchia Meeker, and Kenneth Eells. Chicago: Science Research Associates, 1949. Pp. xiii + 274. $4.25.

These two books, both written by sociologists, describe the social classes in a Midwestern town which is called Elmtown in one book and Jonesville in the other.

Elmtown's youth is "an analysis of the way the social system organizes and controls the social behavior of high-school-aged adolescents reared in it." The purpose of *Social class in America* is not the description of the town as such, but rather, the exposition of methods of analyzing social classes, with illustrative material drawn from this town.

Considered together, the two volumes detract from each other. Two sets of pseudonyms are used; yet the characters are recognizable from one book to the other, since the leading citizens and informers are naturally the same for both. Incidents are somewhat disguised to protect the identity of the inhabitants, and these disguises also vary, giving a feeling of unreality to the same events in this very real community.

Considered separately, the volumes represent two important contributions in the study of community life in America.

In *Elmtown*, Dr. Hollingshead found 735 adolescents of high school age in a community of some 10,000 people. The community tended to ignore the 345 adolescents who were not in school. In general, the children remaining in high school belonged to the families in better and more stable economic position.

Many fascinating details are given of the methods used to teach children "acceptable and unacceptable behavior relative to the family, the job, property, money, the school, the government, men, women, sex, and recreation. It is perfectly normal for families in the same or an adjacent [social] class, concentrated in a particular residential area, . . . to provide their children with significantly different learning situations from those of families in other classes who live in other residential areas."

The analysis of the process by which the young unskilled worker adjusts to the demands of the working world is particularly interesting. The adolescent takes a job to secure "freedom" (from school and from dependence on his parents). The jobs "are mean, dirty, undesirable, and generally seasonal or temporary." These factors "produce discontent and frustration, which motivate the young worker to seek another job, only to realize after a few weeks that the new job is like the old one." The average boy holds five jobs in his first year to a year and a half out of school. Afterwards, he becomes a more stable worker at a slightly higher rate of pay.

In *Social class in America*, Dr. Warner and his co-authors give two measures for analyzing social class. The crux of "Evaluated Participation" is persuading a community to judge each other's social class. "The Index of Status Characteristics" consists essentially of the sociologist rating the individual by judging his position in the social hierarchy in regard to occupation, source of income, house type, and dwelling area. These facts can ordinarily be secured easily.

The book is probably not the final one in the series written by Warner and collaborators. In the reviewer's opinion, there will be still further refinements of these measures. The present exposition will convince most readers, however, of the reality of social class; and will teach something about the methods of studying a community.

My own reaction to the scales of social class is that the values used for them are those of the small-town banker. Most scientists at one time or another must meet the inspection of the banker. But in addition, scientists class each other's prestige on a scale having little in common with the banker's.

A class structure for university scientists might be constructed along the following lines:

Upper-Upper.	Has the highest originality; constructs theories which other scientists test for years to come.
Lower-Upper.	Spends all possible time on research. Constructs theories dealing with limited areas. Envies the originality of the Upper-Upper.
Upper-Middle.	Is a revered teacher of younger scientists. Can verbalize the theories proposed by two upper classes adequately. Publishes an occasional research paper.
Lower-Middle.	Teaches other scientists, but has no reputation. Has published nothing but his doctoral dissertation.
Upper-Lower.	Teaches a scientific subject in a routine manner to students who are not enthusiastic. Turns in grades promptly at the end of the term.
Lower-Lower.	Fails to meet his classes. His students complain to the administration about him. His knowledge is limited; he takes to telling jokes unrelated to his subject.

A farming community such as Jonesville (Elmstown) places at the top people who have been prosperously living there for some generations. A group of scientists might place at the top an individual who has been rapidly promoted from one institution to another, with consequent impoverishment of his bank account, and with the additional factor that his neighbors in a physical sense might not know him. Sociologists will have to take account of the fact that the human being is complicated enough to strive in more than one type of prestige structure.

HELEN M. WOLFLE
American Psychological Association

NEWS and Notes

Paul P. Ewald, professor of mathematical physics at Queen's University, Belfast, has arrived here to become chairman of the Department of Physics at the Polytechnic Institute of Brooklyn. Dr. Ewald, who is the editor of *Acta Crystallographica*, plans to return to experimental work in the physics of the solid state.

Robert S. Hotchkiss, formerly at Cornell University Medical College, has been appointed professor and chairman of the Department of Urology, New York University Post-Graduate Medical School, a unit of the New York University-Bellevue Medical Center. Dr. Hotchkiss will be in charge of all urological research, teaching, and patient care at the Medical Center.

Sergio De Benedetti, professor of physics at Washington University, St. Louis, has joined the staff of the Physics Department at Carnegie Institute of Technology, Pittsburgh. Dr. De Benedetti was associated with the Curie Laboratory in Paris during the war.

Linus Pauling, president of the American Chemical Society, and director of the Department of Chemistry, California Institute of Technology, will deliver the second bicentennial science lecture of the City College Chemistry Alumni Association on December 7 at City College, New York. Dr. Pauling will talk on "Structural Chemistry in Relation to Biology and Medicine."

Wallace Waterfall, formerly director of research and product development for the Celotex Corporation, has been appointed to the newly created position of executive secretary of the American Institute of Physics. Mr. Waterfall has been a member of the AIP Governing Board since 1934 and its secretary since 1945.

I. C. Gunsalus, professor of bacteriology, Indiana University, will deliver the second Harvey Lecture of the current series at the New York Academy of Medicine on November 17. Dr. Gunsalus will speak on "Comparative Metabolism: Bacterial Nutrition and Metabolic Function."

Visitors to U. S.

J. F. Toennies, neurophysiologist, formerly with the Rockefeller Institute in New York, and now engaged in electronic developments in Freiburg, Germany, is visiting various institutions in this country. He may be reached at the Institute for Cancer Research, Fox Chase, Philadelphia 11, Pennsylvania until December 10, when he returns to Freiburg.

The University of Cincinnati section of Sigma Xi presented **Raymond A. Dart,** of the University of Witwatersrand, Johannesburg, as its first lecturer of the academic year, on October 28. Dr. Dart is visiting a number of university centers, under the sponsorship of the Rockefeller Foundation. In addition to the Cincinnati lecture he has presented a series of Lowell lectures at Cambridge, as well as others in this country and Canada. Dr. Dart, discoverer of *Australopithecus*, lectured on "The Fossil Man-Apes from South Africa," illustrating his lecture with slides, casts, and fossils from his work at Taungs and Makapan.

Visitors at the National Bureau of Standards during the week of October 3–7 included: **George Campbell** of the Plessney Company, Ilford, Essex, England; **G. Herzberg,** chief, Division of Physics, National Research Council, Ottawa; **G. David Scott,** assistant professor of physics, University of Toronto, Canada; **A. Strasheim,** senior scientific officer, National Physical Laboratory, Pretoria, South African Union; **Richard Wieweg,** professor, Technischen Hochschule, Darmstadt, Germany; **F. C. Williams,** professor of mathematics, University of Manchester, England; and **R. W. Callon,** chief spectroscopist, Aluminum Laboratories, Ltd., Quebec.

Martin Gusinde, of Vienna, has been appointed visiting professor of ethnology at the Catholic University of America. Dr. Gusinde is giving graduate courses in general ethnology, and on the Indians of South America and the Pygmies of Africa and Asia.

Fritz Strauss, prosector in the Anatomical Institute of the University of Bern, is doing research on problems of mammalian reproduction at the Department of Anatomy of the University of Wisconsin. He plans to be there most of the 1949–50 academic year.

A. Smekal, professor of physical chemistry, University of Darmstadt, Germany, **Eric K. Rideal,** director of the Royal Institution of London, and **W. G. Burgers,** professor of physical chemistry at the Polytechnic Institute, Delft, Holland, were speakers at the Conference on the Solid State at the Polytechnic Institute of Brooklyn, New York, on October 15.

Grants and Awards

The Nobel Peace Prize for 1949 has been awarded to Lord Boyd Orr, Scottish physiologist and former director general of the United Nations Food and Agriculture Organization. Lord Boyd Orr was president of the Congress of World Federalists, held recently in Stockholm, and he plans to use the prize (this year it amounts to about $21,000) to further the world federalist movement.

Rutgers University has announced the award to faculty members of 62 research grants totaling $85,560 from the University Research Fund. The grants are for the year ending June 30, 1950. Thirteen grants, totaling $14,710, were made in the field of biological sciences. Sixteen grants, totaling $24,385, were in mathematics and the physical sciences. Four, for a total of $13,490, were made to support research projects in engineering. The other 29 grants were designated for the humanities and social sciences.

The Acoustics Laboratory of the Massachusetts Institute of Technology has announced the following fellowship grants in architectural

acoustics for the academic year 1949–50: the Armstrong Cork Company Fellowship to Jordan J. Baruch, of Brooklyn, New York; the Acoustical Materials Association Fellowship to Uno Ingard, of Gothenburg, Sweden.

Fellowships

The Harry Bateman Research Fellowships in pure mathematics are being offered for 1950–51 at the California Institute of Technology. Fellows must hold a Ph.D. degree and will devote the major portion of their time to research. In addition, they are expected to teach one advanced course in mathematics. The stipend is $3,600 for the academic year. For application blanks and further information, address the Dean of the Faculty, California Institute of Technology, Pasadena 4, California. Applications must be returned before *February 15, 1950.*

At the request of the **Office of Naval Research,** the National Research Council has appointed an advisory committee of astronomers to recommend specific research projects in astronomy and astrophysics for support by ONR. The committee has suggested that the average cost per project should be about $3,000, with a maximum of $5,000. When a proposal is selected for support by ONR, negotiations will be entered into for a contract between the U. S. Navy and the institution at which the research will be conducted. Applications for the support of projects to be considered this winter should be received at the ONR on or before *December 15.* Full information may be obtained from the Chief of Naval Research, Washington 25, D. C., Attention: Code 432.

The Educational Testing Service is offering two research fellowships in psychometrics for 1950–51, leading to the Ph.D. degree at Princeton University. Each carries a stipend of $2,375 a year and is renewable. Fellows will be engaged in part-time research in the general area of psychological measurement at the offices of the Educational Testing Service and will carry a normal program in the Graduate School. Information and application blanks may be obtained from the Director of the Psychometric Fellowship Program, Educational Testing Service, Box 592, Princeton, New Jersey.

Colleges and Universities

The University of Washington's $1,050,000 School of Fisheries Building, located on Portage Bay, will be occupied by the school and its associated laboratories soon after January 1, 1950. The new building will house complete facilities for biological research, including the measurement of the effects of radiation on aquatic organisms being carried on under the direction of Lauren R. Donaldson, in conjunction with the Atomic Energy Commission.

The University of Pittsburgh School of Medicine has opened its new Addison H. Gibson Laboratory, established by a grant from the Addison H. Gibson Foundation, to provide additional facilities for studies in applied physiology. The laboratory will investigate problems of arteriosclerosis and provide service facilities for the handling of radioactive isotopes. Campbell Moses has been appointed director.

Meetings and Elections

Stanford University School of Medicine will present its 30th course of Lane Medical Lectures, October 31–November 10 at 8:15 p.m. in Lane Hall, 2398 Sacramento Street, San Francisco. The lectures will be delivered by James L. Gamble, professor of pediatrics and chairman of the Department of Pediatrics, Harvard Medical School, on various phases of the companionship of water and eiectrolytes in the organization of body fluids.

The American Petroleum Institute will hold its 29th annual meeting in Chicago, November 7–10. Two general sessions will be held on the afternoon and evening of November 9. On November 10 the Division of Refining will hold a group session on "Fuels of the Future." Papers will be presented at this session by William M. Holaday, of Socony-Vacuum Oil Company, Inc., and by Walter G. Whitman, of Massachusetts Institute of Technology.

The American Society of Mechanical Engineers will hold its 70th annual meeting at the Statler Hotel, New York City, November 28–December 2. Seventy-eight technical sessions will be sponsored by 22 professional divisions and committees of ASME, covering the fields of power, aviation, applied mechanics, fuels, gas turbines, heat transfer, hydraulics, industrial instruments and regulators, machine design, management, materials handling, metals engineering, oil and gas power, process industries, production engineering, railroad, rubber and plastics, textiles, wood industries, and petroleum.

Among the speakers at the meeting will be H. J. Gough, president of the Institution of Mechanical Engineers of Great Britain, Lillian M. Gilbreth, outstanding women engineer, F. C. Hottel, of the Massachusetts Institute of Technology, Paul C. Aebersold, chief of the Isotopes Division, Oak Ridge, Tennessee, and Hugh L. Dryden, director of aeronautical research for the National Advisory Committee for Aeronautics.

A national conference on cardiovascular diseases will be held in Washington, D. C., January 18–20, under the joint sponsorship of the American Heart Association and the National Heart Institute of the U. S. Public Health Service. H. M. Marvin, president of the American Heart Association, and C. J. Van Slyke, director of the National Heart Institute, will be cochairmen of the conference, which will bring together physicians, scientists, community service leaders, and members of allied professions to formulate a comprehensive heart disease control program.

The American Meteorological Society's 30th anniversary meeting in St. Louis, January 3–6, 1950, will feature an air pollution symposium. One part of the symposium will be a panel discussion on the different phases of air pollution abatement. This discussion will be open to scientists, technicians, and the public and, following a brief description of each panel member's special subject,

their comments and questions from the floor will be invited. The second part will be a series of technical papers, selected to emphasize the meteorological and climatological phases of air pollution, including urban diffusion of smokes, forecasting atmospheric dispersion conditions, dispersion from stacks, and climate influences on pollution.

Chairman of the symposium is C. A. Gosline, of the E. I. du Pont de Nemours and Company, Inc., Wilmington, Delaware.

The Southern Association of Science and Industry will hold its winter meeting January 23–24 at the Hotel Roosevelt, in New Orleans. Paul W. Chapman, dean of the University of Georgia, has been named general program chairman, and James N. Gowanloch, chief biologist of the Wildlife and Fisheries Department, of New Orleans, will be chairman of the committee on local arrangements. There will be three discussion sessions on the use of research in increasing farm production efficiency, preserving and transporting farm products, and finding industrial uses for these products.

The American Association of the History of Medicine will hold its 1950 annual meeting in Boston May 21–23. Members of the association who wish to submit papers should communicate with the chairman of the program committee, Dr. Harold Bowditch, 44 Harvard Avenue, Brookline, Massachusetts. Papers must be submitted before *January 15*.

The Worcester Foundation for Experimental Biology has elected the following trustees for a term of four years: Charles B. Huggins, professor of surgery at the University of Chicago; Rear Admiral George W. Calver, U.S.N. (M.C.); and Ralph F. Gow, executive vice president of the Norton Company.

The Institut Internationale d'Embryologie, an elective body of 75 members, affiliated with Unesco, elected the following officers at a recent meeting in Bern, Switzerland: president, M. W. Woerdeman, Holland; vice presidents, E. Fauré-Fremiet, France; F. E. Lehmann, Switzerland; Paul Weiss, U. S.; executive committee members, G. R. de Beer, Great Britain, and A. Dalcq, Belgium; and secretary-treasurer, C. P. Raven, Holland.

The Coordinating Committee on Abstracting and Indexing of Medical and Biological Sciences met in Paris, at Unesco House, June 1–4, under the sponsorship of the Natural Sciences Section of Unesco and the World Health Organization. The meeting was efficiently organized by I. M. Zhukova, head of Applied Sciences, Unesco. Hugh Clegg, Editor of the *British Medical Journal*, served as chairman, and M. W. Woerdeman, editor-in-chief of *Excerpta Medica* and Eileen R. Cunningham, Vanderbilt University School of Medicine, served as vice chairmen. The meeting was opened by addresses from Director-General J. Torres Bodet; P. Auger, director of the Division of Natural Sciences; N. Howard-Jones, director of library and reference services, WHO; and F. Verzar, who spoke from the point of view of the Food and Agriculture Organization.

Several important decisions were made during the meeting. First, the members felt that the usefulness of the committee which, up to now, has been functioning on an interim basis, had been fully demonstrated. After an appraisal of past activities and a discussion of future plans for work the members voted unanimously to continue on a permanent basis under their present relationship to Unesco. Second, while the committee recognized that adequate indexing of medical literature presents certain problems not comparable to those of abstracting, it was felt that these two methods of making information concerning current literature available to scientists are, in many ways, so closely related that the scope of the committee's activities should be enlarged to include indexing as well.

Papers given during the meeting presented the views of the users of abstract services, as well as problems involved in the production of abstracts. Much evidence was presented indicating the desirability of having the bibliographic detail of the entry as complete as possible. and of having the author's name come first in the bibliographic entry. Both information gathered from users of abstracts, and the expressed views of the members of the committee coincided in advocating the standardization of the bibliographic form used in the various abstracting services.

Standardization of abbreviations, avoidance of local abbreviations, and adoption of the metric system in all medical and biological communications was endorsed by the committee, which also recommended that editors of medical and biological journals adopt greater uniformity in terms and greater precision in the papers appearing in their journals.

Professor Woerdeman and Mrs. Cunningham were appointed as the committee's representatives to the International Conference on Scientific Abstracting, held in Paris, June 20–25, following the meeting of the Coordinating Committee on Abstracting and Indexing of Medical and Biological Sciences (See *Science*, July 29, page 132). Mrs. Cunningham presented a report of the committee's activities, which was discussed during one of the plenary sessions of the conference.

The official U. S. delegation to the international conference consisted of three voting delegates: Verner W. Clapp, of the Library of Congress, who served as chairman of the delegation and one of the vice presidents of the conference; Evan Crane, editor of *Chemical Abstracts*; J. Murray Luck, editor of *Annual Reviews*, and three technical advisers: Mrs. Cunningham, chairman, Medical Library Association's Committee on Abstracting; John E. Flynn, editor of *Biological Abstracts*, and Eugene W. Scott, Inter department Committee on Research and Development. Also present as consultants and observers were Norman T. Ball, Technical Information, Research and Development Board; John E. Burchard, Massachusetts Institute of Technology; Dwight E. Gray, American Institute of Physics; Sanford V. Larkey, Johns Hopkins University, Welch Medical Library; and R. H. Phelps, Engineering Society Library.

The conference voted to establish a provisional international advisory committee to work with Unesco on abstracting for one year, pending the formation of a permanent committee. Appointments to this committee were reported in *Science*, October 7.

EILEEN R. CUNNINGHAM

Deaths

Filippo Silvestri, 76, entomologist, died at Bevagna, Italy, June 10. Dr. Silvestri specialized in the Thysanura, Entotrophi, and Isoptera. He was for many years the director of the Laboratory of Entomology of the Portici branch of the University of Naples, and had retired in 1948. He was a Fellow of the Entomological Society of America.

William Henry Watters, 73, pathologist, died October 10 in Hyannis, Massachusetts. Dr. Watters was at one time professor of pathology at Boston University and for many years had been an associate in the legal department of the Harvard University Medical School.

Robert Tilden Frank, 74, gynecologist, died October 15 in New York City, following a brief illness. Dr. Frank has been associated with Mount Sinai Hospital since 1906. In 1925 he founded its Endocrine Research Laboratory and remained at its head until 1944.

The dedicatory exercises and formal opening of the new laboratories of the **Institute for Cancer Research** and the **Lankenau Hospital Research Institute** in Fox Chase, Philadelphia, are to be held November 15–16. The first day will be devoted to the formal opening exercises, at which Charles F. Kettering will be the principal speaker. On the second day, the subject "Modes of Procedure in Cancer Research" will be discussed by C. C. Little, R. G. Meader, and C. F. Huggins. On both days, open house and demonstrations will be held by the staff.

An inaugural series of scientific programs is being planned for the spring of 1950 and will be announced later.

A limited number of travel allotments to the **Fifth International Cancer Congress** to be held in Paris, July 17–22, 1950, will be available to scientists requiring such assistance. The recipients of the travel allotments will be selected by the several agencies, foundations, or societies that support cancer research and that are contributing the funds. Applications should be submitted in letter form, giving information concerning age, training, publications in cancer or related fields, present academic or professional status, a brief abstract of major current investigative work, and statement of work to be presented at the congress. A letter from the laboratory director or administrative officer approving the application is also necessary. Send applications to W. U. Gardner, Member of Congress Committee, 333 Cedar Street, New Haven, Connecticut before *November 16*.

A Society for Social Responsibility in Science has been formed by a group of scientists and engineers who met at Haverford College, Pennsylvania, on September 15.

The constitution states the aims of the society to be: ". . . to foster throughout the world a . . . tradition of personal moral responsibility for the consequences for humanity of professional activity, with emphasis on constructive alternatives to militarism; to embody in this tradition the principle that the individual must abstain from destructive work and devote himself to constructive work, according to his own moral judgment; to ascertain . . . the boundary between constructive and destructive work, to serve as a guide for individual and group decisions and action; to establish and operate an employment service . . . for those individuals whose convictions necessitate leaving or refusing destructive work; to assist those individuals who suffer economic or legal difficulties because of . . . abstaining from . . . destructive activity."

The first officers are: president, Victor Paschkis, director of an engineering research laboratory of Columbia University; vice president, William F. Hewitt, Jr., physiologist at Howard University School of Medicine; secretary-treasurer, Vincent Cochrane, biologist at Wesleyan University. Elected to the council of the SSRS were Leonard Dart, physicist for American Viscose Corporation, Marcus Hook, Pennsylvania; Theodore B. Hetzel, of the engineering faculty at Haverford College; Franklin Miller, Jr., physicist at Kenyon College, Gambier, Ohio; William T. Scott, physicist at Brookhaven National Laboratory and at Smith College; and James G. Vail, past president of the American Institute of Chemical Engineers.

The society will work on a unanimous basis, rather than by parliamentary procedures. Regional and functional groups of the SSRS are to be organized soon. English, German, and Swiss scientists have expressed interest in the organization. For further information write Victor Paschkis, Hidden Springs, R.D., Neshanic Station, New Jersey.

Recently Received—

The Mapleton Meteorite. Sharat Kumar Roy and Robert Kriss Wyant. Geological Series of Field Museum of Natural History, Chicago. Vol. VII, No. 7. 40¢.

The Vitamin Content of Peas as Influenced by Maturity, Fertilizers, and Variety. Ethelwyn B. Wilcox and Katharine E. Morrell. Agric. Exp. Sta., Bull. 337, Utah State Agricultural College.

Annual Report of the Director of the Department of Terrestrial Magnetism, 1947–48. Merle A. Tuve. Reprint, Carnegie Institution of Washington Year Book No. 47.

Characteristics of Residual Insecticides Toxic to the House Fly. Willis N. Bruce. Illinois Natural History Survey Bull., Vol. 25, Art. 1. State of Illinois Department of Registration and Education, Urbana.

The Spectrum of Nova Persei 1901. Dean B. McLaughlin. Publ. University of Michigan Observatory, Vol. IX, No. 3.